

June 28, 2019  
File No. 262018.063

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Washington Geological Survey  
111 Washington Street SE  
Olympia, Washington 98504

Mr. Scott Black  
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State of Washington  
Office of Superintendent of Public Instruction  
600 Washington Street  
Olympia, Washington 98504

Subject: Department of Natural Resources Washington Geological Survey,  
School Seismic Safety Assessment Project, Contract No. AE 410 -  
Seismic Evaluation for **Boistfort School District**

Dear Ms. Forson and Mr. Black:

Reid Middleton and our consultant team, under the direction of The Department of Natural Resources (DNR) Washington Geological Survey (WGS) School Seismic Safety Project, have conducted seismic evaluations of 222 school buildings and 5 fire stations throughout Washington State. This letter is transmitting the results of these seismic assessments for each school district that graciously participated in this statewide study. We understand that you will be forwarding this letter and the accompanying seismic screening reports to each school district for their reference and use.

Many disparate studies on improving the seismic safety of our public school buildings have been performed over the last several decades. Experts in building safety, geologic hazards, emergency management, education, and even the news media have been asserting for decades that seismic risks in older public school buildings represent a risk to our communities. The time to act is now, before we have a damaging earthquake and/or tsunami that could be catastrophic. This statewide school seismic safety assessment project provides a unique opportunity to draw attention to the need for statewide seismic safety policies and funding on behalf of all school districts that will help enable school districts to increase the seismic safety of their older buildings to make them safer for students, teachers, staff, parents, and the community.

It is not the intent of this study to create an unfunded mandate for school districts to seismically upgrade their schools without associated funding or statewide seismic safety policy support. The overall goal of this study was to screen and evaluate the current levels of seismic vulnerabilities of a statewide selection of our older public school buildings and to use the data and information to help quantify funding and policy needs to improve the seismic safety of our public schools. In this process, we are using the information to inform not only the Governor

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and the Legislature of the policy and funding needs for seismically safe schools but also the school districts that participated in the study.

### **School Buildings Evaluated in the Boistfort School District**

We appreciate Boistfort School District's participation and invaluable assistance in this statewide project. The following school district buildings were included as part of this study:

1. Boistfort Elementary School, Gymnasium Building
2. Boistfort Elementary School, Main Building

The seismic screening of these buildings was performed using the American Society of Civil Engineers' Standard 41-17, *Seismic Evaluation and Retrofit of Existing Buildings* (ASCE 41-17), national standard Tier 1 structural and nonstructural seismic screening checklists specific to each building's structure type.

The WGS also conducted seismic site class assessments to measure the shear wave velocity and determine the soil site class at each campus. Site class is an approximation of how much soils at a site will amplify earthquake-induced ground motions and is a critical parameter used in seismic design. Reid Middleton subsequently used this information in their seismic screening analyses.

The following table is a list of available seismic assessment information used in our study:

<b>School Building</b>	<b>Year Constructed</b>	<b>FEMA Building Classification</b>	<b>Structural Drawings Available for Review</b>
Boistfort Elementary School, Gymnasium Building	1963	Reinforced Masonry Walls with Flexible Diaphragms	No
Boistfort Elementary School, Main Building	1936	Unreinforced Masonry Bearing Walls	Yes

Detailed descriptions of the seismic screening evaluations of these buildings can be found in the individual building reports and the ASCE 41-17 Tier 1 screening checklist documents enclosed with this letter. This information will also be available for download on the WGS website:

<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/earthquakes-and-faults/school-seismic-safety>.

These Tier 1 seismic screening checklists are often the first step employed by structural engineers when trying to determine the seismic vulnerabilities of existing buildings and to begin a process of mitigating these seismic vulnerabilities. School district facilities management personnel and their design consultants should be able to take advantage of this information to help inform and address seismic risks in existing or future renovation, repair, or modernization projects.

It is important to note that information used for these school seismic screenings was limited to available construction drawings and limited site observations by our team of licensed structural engineers to observe the general conditions and configuration of each building being seismically screened. In many cases, construction drawings were not available for review as noted in the table above. Due to the limited scope of the study, our team of engineers were not able to perform more-detailed investigations above ceilings, behind wall finishes, in confined spaces, or in other areas obstructed from view. Where building component seismic adequacy was unknown due to lack of available information, the unknown conditions were indicated as such on the ASCE 41-17 Tier 1 checklists. Additional field investigations are recommended for the “unknown” seismic evaluation checklist items if more-definitive determinations of seismic safety compliance and further development of seismic mitigation strategies are desired.

### **Nonstructural Seismic Screening**

The enclosed ASCE 41-17 Tier 1 Nonstructural Seismic Screening checklists can provide immediate guidance on seismic deficiencies in nonstructural elements. Mitigating the risk of earthquake impacts from these nonstructural elements should be addressed as soon as practical by school districts. Some nonstructural elements may be easily mitigated by installing seismic bracing of tall cabinets, moving heavy contents to the bottom of shelving, and adding seismic strapping or bracing to water tanks and overhead elements (light fixtures, mechanical units, piping, fire protection systems, etc.).

It is often most economical to mitigate nonstructural seismic hazards when the building is already undergoing mechanical, electrical, plumbing, or architectural upgrades or modernizations. Enclosed with these nonstructural seismic screening checklists are excerpts from the Federal Emergency Management Agency (FEMA) publication E-74 entitled, *Reducing the Risks of Nonstructural Earthquake Damage* (FEMA E-74). We have included these FEMA publication excerpts to help illustrate typical seismic mitigation measures that can potentially be implemented by district facilities and maintenance personnel.

### **Structural Seismic Screening**

The enclosed ASCE 41-17 Tier 1 Structural Seismic Screening checklists have evaluation statements that are reviewed for specific building elements and systems to determine if these items are seismically compliant, noncompliant, not applicable, or unknown. These evaluation statements provide guidance on which structural systems and elements have identified seismic deficiencies and should be investigated further. Further seismic evaluations beyond these seismic screening checklists typically consist of more-detailed seismic structural analyses to better define the seismic vulnerabilities and risks. This information is then used to determine cost-effective ways to seismically improve these buildings with stand-alone seismic upgrade projects or incrementally as part of other ongoing building maintenance, repair, or modernization projects. Consequently, implementing seismic structural mitigation strategies

typically requires that they be developed as a part of longer-term capital improvements and modernization programs developed by the school district and their design consultants.

### Next Steps

Due to the screening nature of the ASCE 41-17 Tier 1 procedures, an in-depth seismic evaluation and analysis of these buildings may be needed before detailed seismic upgrades or improvements, conceptual designs, and probable construction cost estimates are developed.

If you have any questions or comments regarding the engineering reports or would like to discuss this further, please contact us.

Sincerely,



David B. Swanson, P.E., S.E.  
Principal, LEED AP, F.SEI



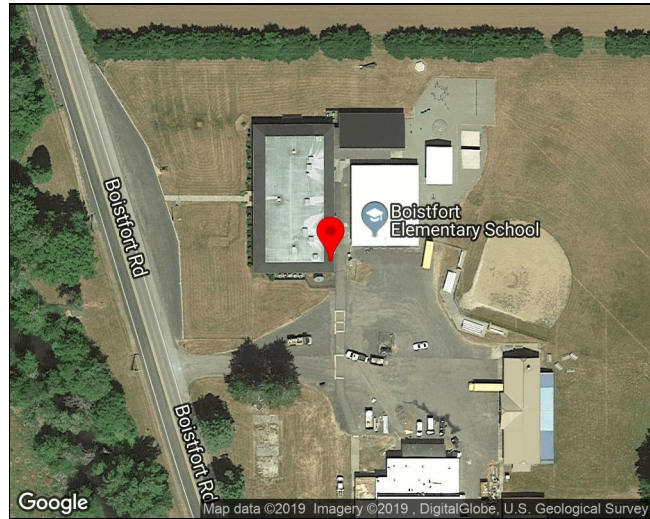
### Limitations

The professional services described in this document were performed based on available information and limited visual observation of the structures. No other warranty is made as to the professional advice included in this document. This document has been prepared for the exclusive use of the Department of Natural Resources, the Office of the Superintendent of Public Instruction, and this school district and is not intended for use by other parties, as it may not contain sufficient information for other parties' purposes or their uses.

# 1. Boistfort, Boistfort Elementary, Gymnasium Building

## 1.1 Building Description

Building Name:	Gymnasium Building
Facility Name:	Boistfort Elementary
District Name:	Boistfort
ICOS Latitude:	46.55
ICOS Longitude:	-123.133
ICOS	
County/District ID:	21234
ICOS Building ID:	16933
ASCE 41 Bldg Type:	RM1
Enrollment:	99
Gross Sq. Ft. :	14,530
Year Built:	1963
Number of Stories:	1
S <sub>XS</sub> BSE-2E:	0.948
S <sub>X1</sub> BSE-2E:	0.610
ASCE 41 Level of Seismicity:	High
Site Class:	D
V <sub>S30</sub> (m/s):	320
Liquefaction Potential:	Moderate to High
Tsunami Risk:	None
Structural Drawings Available:	No
Evaluating Firm:	WRK Engineers



The Boistfort Elementary School gymnasium building is a one-story reinforced masonry and wood-framed structure. The building is constructed on level ground and is located in Curtis, Washington. The 1963 building is 170 feet by 100 feet with a maximum roof height of 25 feet. Building construction consists of reinforced masonry walls and wood-stud walls. The floor system is concrete slab-on-grade at the gym and a wood-framed elevated floor at the multi-purpose room. The roof system is wood-framed stress-skin panels over glulam beams. The building shares a site with the main building, a play shed, and various outbuildings.

### 1.1.1 Building Use

The building is a gymnasium for the Boistfort Elementary School and includes the gymnasium, a multipurpose room, locker rooms, storage, mechanical rooms, and a kitchen. The PK-8 elementary school has over 90 student occupants.

### 1.1.2 Structural System

**Table 1.1-1. Structural System Description of Boistfort Elementary**

Structural System	Description
Structural Roof	The roof system is composed of stress-skin wood panels over glulam beams. The stress-skin panels consist of plywood sheathing over 2x dimensional lumber framing.
Structural Floor(s)	The main floor consists of a concrete slab-on-grade. The elevated floor at the multipurpose room consists of T&G decking over wood framing.
Foundations	The foundation consists of cast-in-place reinforced concrete shallow spread footings supporting wall piers and columns, as well as concrete strip footings supporting reinforced masonry and wood stud bearing walls.
Gravity System	The gravity system consists of a wood-framed roof supported by glulam and solid-sawn beams supported by reinforced masonry bearing walls, wood stud bearing walls, and steel columns.
Lateral System	A mixture of wood shear walls and reinforced masonry walls with a structural diaphragm resists the forces in the longitudinal and transverse directions.

### 1.1.3 Structural System Visual Condition

**Table 1.1-2. Structural System Condition Description of Boistfort Elementary**

Structural System	Description
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Structural Floor(s)	No visible signs of corrosion, damage, or deterioration.
Foundations	Unknown.
Gravity System	No visible signs of corrosion, damage, or deterioration.
Lateral System	No visible signs of corrosion, damage, or deterioration.

## 1.2 Seismic Evaluation Findings

### 1.2.1 Structural Seismic Deficiencies

The structural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation.

**Table 1-3. Identified Structural Seismic Deficiencies for Boistfort Boistfort Elementary Gymnasium Building**

Deficiency	Description
Load Path	The windows along the east and west sides of the gymnasium create a break in the load path from the roof diaphragm to the masonry shear walls. In-plane strengthening is recommended, such as infilling windows with CMU or adding new shear walls or braced frames along the east and west sides.
Shear Stress Check	Shear stress for CMU walls is compliant. However, corresponding check for W2 system is non-compliant. The building likely requires lateral strengthening through the addition of new masonry shear walls. Further investigation is required.
Wall Anchorage	Roof exterior CMU wall connection types and extent are unknown. This evaluation item is likely non-compliant due to the building's age, but could not be visually verified. This item requires further field investigation to make a final determination on its compliance. The addition of out-of-plane wall anchors, blocking, and strapping is likely required.
Transfer to Shear Walls	There is no connection between the gymnasium roof diaphragm and the east/west masonry walls. Existing wall anchorage elsewhere is likely insufficient to transfer roof diaphragm loads to the shear walls. Post-installed anchors should be installed between the roof diaphragm and the existing masonry walls.
Cross Ties	There are no continuous cross ties between diaphragm chords. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of new cross ties between diaphragm chords or adding strap plates to connect the existing framing members together.
Diagonally Sheathed and Unblocked Diaphragms	This evaluation cannot be visually verified, but is likely non-compliant. This item requires further investigation to make a final determination on its compliance. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of diaphragm blocking and increased nailing.

### 1.2.2 Structural Checklist Items Marked as 'Unknown'

Where building structural component seismic adequacy was unknown due to lack of available information or limited observation, the structural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown structural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

**Table 1-4. Identified Structural Checklist Items Marked as Unknown for Boistfort Boistfort Elementary Gymnasium Building**

Unknown Item	Description
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. Moderate to high liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Ties Between Foundation Elements	No structural drawings are available. This evaluation item is unknown and cannot be visually verified. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Reinforcing Steel	The reinforcing steel size and spacing for the masonry walls is unknown based on the available as-built information. This item requires further field investigation to make a final determination on its compliance. The addition of FRP or vertical HSS strongbacks may be appropriate.
Wood Ledgers	This evaluation item is unknown and likely non-compliant due to the building's age. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Girder-Column Connection	No structural drawings are available. This evaluation item is unknown and cannot be visually verified. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Stiffness of Wall Anchors	This evaluation item is unknown and could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.



### 1.3.1 Nonstructural Seismic Deficiencies

The nonstructural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation. Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

**Table 1-5. Identified Nonstructural Seismic Deficiencies for Boistfort Boistfort Elementary Gymnasium Building**

Deficiency	Description
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	Partition wall at entrance to boys' locker room is likely unbraced based on the age of the building. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary. Unreinforced masonry partition walls should be braced at spacing of six feet or demolished.

### 1.3.2 Nonstructural Checklist Items Marked as 'Unknown'

Where building nonstructural component seismic adequacy was unknown due to lack of available information or limited observation, the nonstructural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown nonstructural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

**Table 1-6. Identified Nonstructural Checklist Items Marked as Unknown for Boistfort Boistfort Elementary Gymnasium Building**

Unknown Item	Description
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Emergency power equipment was not observed. Based on the age of the building, emergency power is likely non-existent or non-compliant. Further investigation is required to review the life-safety system anchorage and bracing.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	This evaluation item is unknown and likely non-compliant due to the building's age. This item requires further field investigation to review suspended ceiling attachments.
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	This item requires further investigation to review the support system for light fixtures and to make a final determination on its compliance. Light fixture bracing is likely inadequate and the addition of bracing may be appropriate to mitigate seismic risk.
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Tall narrow contents do not appear to be anchored to the structure or to each other. Contents more than six feet high should be anchored to provide overturning base restraint.
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Mechanical equipment in-line with the duct or piping system weighing more than 75 pounds does not appear to be braced or restrained, but cannot be visually verified. This item requires further investigation to review vertical support and lateral bracing of equipment.
ME-3 Tall Narrow Equipment. HR-not required; LS-H; PR-MH.	Further investigation required to review anchorage of tall narrow equipment. All tall narrow mechanical equipment should be braced or anchored to the structure.

Photos:



**Figure 1-1. Boistfort Gym - West Exterior**



**Figure 1-2. Boistfort Gym - South Exterior**



**Figure 1-3. Boistfort Gym - East Exterior**



**Figure 1-4. Boistfort Gym - North Exterior**





**Figure 1-5. Unbraced Nonstructural Partition Wall at Entry**



**Figure 1-6. Locker Room with Unbraced Half-Height Partition Walls**



**Figure 1-7. Gymnasium - North Interior**



Figure 1-8. Mechanical Room





**Figure 1-9. Multipurpose Room with Unknown Light Fixture Bracing, Typical Throughout**



**Figure 1-10. Kitchen - Large Nonstructural Components Unbraced**



## Boistfort, Boistfort Elementary, Gymnasium Building

### 17-2 Collapse Prevention Basic Configuration Checklist

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

#### Low Seismicity

##### Building System - General

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Load Path	The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Tier 2: Sec. 5.4.1.1; Commentary: Sec. A.2.1.10)		X			The windows along the east and west sides of the gymnasium create a break in the load path from the roof diaphragm to the masonry shear walls. In-plane strengthening is recommended, such as infilling windows with CMU or adding new shear walls or braced frames along the east and west sides.
Adjacent Buildings	The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Tier 2: Sec. 5.4.1.2; Commentary: Sec. A.2.1.2)	X				
Mezzanines	Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Tier 2: Sec. 5.4.1.3; Commentary: Sec. A.2.1.3)			X		

##### Building System - Building Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Weak Story	The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Tier 2: Sec. 5.4.2.1; Commentary: Sec. A.2.2.2)			X		

Soft Story	The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Tier 2: Sec. 5.4.2.2; Commentary: Sec. A.2.2.3)			X		
Vertical Irregularities	All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Tier 2: Sec. 5.4.2.3; Commentary: Sec. A.2.2.4)	X				
Geometry	There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 5.4.2.4; Commentary: Sec. A.2.2.5)			X		
Mass	There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 5.4.2.5; Commentary: Sec. A.2.2.6)			X		
Torsion	The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Tier 2: Sec. 5.4.2.6; Commentary: Sec. A.2.2.7)	X				

### **Moderate Seismicity** (Complete the Following Items in Addition to the Items for Low Seismicity)

#### **Geologic Site Hazards**

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Liquefaction	Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.1)				X	The liquefaction potential of site soils is unknown at this time given available information. Moderate to high liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.2)				X	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.

Surface Fault Rupture	Surface fault rupture and surface displacement at the building site are not anticipated. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.3)				X	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
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## High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)

### Foundation Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Overturning	The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6Sa. (Tier 2: Sec. 5.4.3.3; Commentary: Sec. A.6.2.1)	X				
Ties Between Foundation Elements	The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Tier 2: Sec. 5.4.3.4; Commentary: Sec. A.6.2.2)				X	No structural drawings are available. This evaluation item is unknown and cannot be visually verified. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

## 17-34 Collapse Prevention Structural Checklist for Building Types RM1 and RM2

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

### Low and Moderate Seismicity

#### Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Redundancy	The number of lines of shear walls in each principal direction is greater than or equal to 2. (Tier 2: Sec. 5.5.1.1; Commentary: Sec. A.3.2.1.1)	X				
Shear Stress Check	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.2 (0.48 MPa). (Tier 2: Sec. 5.5.3.1.1; Commentary: Sec. A.3.2.4.1)		X			Shear stress for CMU walls is compliant. However, corresponding check for W2 system is non-compliant. The building likely requires lateral strengthening through the addition of new masonry shear walls. Further investigation is required.
Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in. (1220 mm), and all vertical bars extend to the top of the walls. (Tier 2: Sec. 5.5.3.1.3; Commentary: Sec. A.3.2.4.2)				X	The reinforcing steel size and spacing for the masonry walls is unknown based on the available as-built information. This item requires further field investigation to make a final determination on its compliance. The addition of FRP or vertical HSS strongbacks may be appropriate.

#### Stiff Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Topping Slab	Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab. (Tier 2: Sec. 5.6.4; Commentary: Sec. A.4.5.1)			X		

#### Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
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Wall Anchorage	Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Tier 2: Sec. 5.7.1.1; Commentary: Sec. A.5.1.1)		X			Roof exterior CMU wall connection types and extent are unknown. This evaluation item is likely non-compliant due to the building's age, but could not be visually verified. This item requires further field investigation to make a final determination on its compliance. The addition of out-of-plane wall anchors, blocking, and strapping is likely required.
Wood Ledgers	The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 5.7.1.3; Commentary: Sec. A.5.1.2)				X	This evaluation item is unknown and likely non-compliant due to the building's age. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Transfer to Shear Walls	Diaphragms are connected for transfer of seismic forces to the shear walls. (Tier 2: Sec. 5.7.2; Commentary: Sec. A.5.2.1)		X			There is no connection between the gymnasium roof diaphragm and the east/west masonry walls. Existing wall anchorage elsewhere is likely insufficient to transfer roof diaphragm loads to the shear walls. Post-installed anchors should be installed between the roof diaphragm and the existing masonry walls.
Topping Slab to Walls or Frames	Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements. (Tier 2: Sec. 5.7.2; Commentary: Sec. A.5.2.)			X		
Foundation Dowels	Wall reinforcement is doweled into the foundation. (Tier 2: Sec. 5.7.3.4; Commentary: Sec. A.5.3.5)	X				

Girder-Column Connection	There is a positive connection using plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 5.7.4.1; Commentary: Sec. A.5.4.1)				X	No structural drawings are available. This evaluation item is unknown and cannot be visually verified. This item requires further investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
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## High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)

### Stiff Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Openings at Shear Walls	Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.4)			X		
Openings at Exterior Masonry Shear Walls	Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.6)			X		

### Flexible Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Cross Ties	There are continuous cross ties between diaphragm chords. (Tier 2: Sec. 5.6.1.2; Commentary: Sec. A.4.1.2)		X			There are no continuous cross ties between diaphragm chords. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of new cross ties between diaphragm chords or adding strap plates to connect the existing framing members together.
Openings at Shear Walls	Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.4)			X		
Openings at Exterior Masonry Shear Walls	Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.6)			X		
Straight Sheathing	All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.1)			X		
Spans	All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.2)	X				

Diagonally Sheathed and Unblocked Diaphragms	All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4 to-1. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.3)		X			This evaluation cannot be visually verified, but is likely non-compliant. This item requires further investigation to make a final determination on its compliance. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of diaphragm blocking and increased nailing.
Other Diaphragms	Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 5.6.5; Commentary: Sec. A.4.7.1)	X				

### Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Stiffness of Wall Anchors	Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. (3 mm) before engagement of the anchors. (Tier 2: Sec. 5.7.1.2; Commentary: Sec. A.5.1.4)				X	This evaluation item is unknown and could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

## Boistfort, Boistfort Elementary, Gymnasium Building

### 17-38 Nonstructural Checklist

Notes:

C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Performance Level: HR = Hazards Reduced, LS = Life Safety, and PR = Position Retention.

Level of Seismicity: L = Low, M = Moderate, and H = High

#### Life Safety Systems

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LSS-1 Fire Suppression Piping. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping is anchored and braced in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.1)			X		No fire sprinklers
LSS-2 Flexible Couplings. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping has flexible couplings in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.2)			X		
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Equipment used to power or control Life Safety systems is anchored or braced. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.1)				X	Emergency power equipment was not observed. Based on the age of the building, emergency power is likely non-existent or non-compliant. Further investigation is required to review the life-safety system anchorage and bracing.
LSS-4 Stair and Smoke Ducts. HR-not required; LS-LMH; PR-LMH.	Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.1)			X		
LSS-5 Sprinkler Ceiling Clearance. HR-not required; LS-MH; PR-MH.	Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.3)			X		
LSS-6 Emergency Lighting. HR-not required; LS-not required; PR-LMH	Emergency and egress lighting equipment is anchored or braced. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.1)			X		

#### Hazardous Materials

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
HM-1 Hazardous Material Equipment. HR-LMH; LS-LMH; PR-LMH.	Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.2)			X		



HM-2 Hazardous Material Storage. HR-LMH; LS-LMH; PR-LMH.	Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 13.8.3; Commentary: Sec. A.7.15.1)			X		
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)			X		
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	Piping containing hazardous material, including natural gas, has shutoff valves or other devices to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.3)			X		
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Hazardous material ductwork and piping, including natural gas piping, have flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.15.4)			X		
HM-6 Piping or Ducts Crossing Seismic Joints. HR-MH; LS-MH; PR-MH.	Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5, 13.7.6; Commentary: Sec. A.7.13.6)			X		

### Partitions

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft (3.0 m) in Low or Moderate Seismicity, or at most 6 ft (1.8 m) in High Seismicity. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.1)		X			Partition wall at entrance to boys' locker room is likely unbraced based on the age of the building. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary. Unreinforced masonry partition walls should be braced at spacing of six feet or demolished.
P-2 Heavy Partitions Supported by Ceilings. HR-LMH; LS-LMH; PR-LMH.	The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		

P-3 Drift. HR-not required; LS-MH; PR-MH.	Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.2)			X		
P-4 Light Partitions Supported by Ceilings. HR-not required; LS-not required; PR-MH.	The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
P-5 Structural Separations. HR-not required; LS-not required; PR-MH.	Partitions that cross structural separations have seismic or control joints. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
P-6 Tops. HR-not required; LS-not required; PR-MH.	The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft (1.8 m). (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

### Ceilings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft <sup>2</sup> (1.1 m <sup>2</sup> ) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)			X		
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft <sup>2</sup> (1.1 m <sup>2</sup> ) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)				X	This evaluation item is unknown and likely non-compliant due to the building's age. This item requires further field investigation to review suspended ceiling attachments.
C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft <sup>2</sup> (13.4 m <sup>2</sup> ) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.2)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

C-4 Edge Clearance. HR-not required; LS-not required; PR-MH.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft <sup>2</sup> (13.4 m <sup>2</sup> ) have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in. (13 mm); in High Seismicity, 3/4 in. (19 mm). (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.4)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
C-5 Continuity Across Structure Joints. HR-not required; LS-not required; PR-MH.	The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.5)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
C-6 Edge Support. HR-not required; LS-not required; PR-H.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft <sup>2</sup> (13.4 m <sup>2</sup> ) are supported by closure angles or channels not less than 2 in. (51 mm) wide. (Tier 2: Sec. 13.6.4 ; Commentary: Sec. A.7.2.6)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
C-7 Seismic Joints. HR-not required; LS-not required; PR-H.	Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2,500 ft <sup>2</sup> (232.3 m <sup>2</sup> ) and has a ratio of long-to-short dimension no more than 4-to-1. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.7)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

#### Light Fixtures

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Tier 2: Sec. 13.6.4, 13.7.9; Commentary: Sec. A.7.3.2)				X	This item requires further investigation to review the support system for light fixtures and to make a final determination on its compliance. Light fixture bracing is likely inadequate and the addition of bracing may be appropriate to mitigate seismic risk.
LF-2 Pendant Supports. HR-not required; LS-not required; PR-H.	Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft. Unbraced suspended fixtures are free to allow a 360-degree range of motion at an angle not less than 45 degrees from horizontal without contacting adjacent components. Alternatively, if rigidly supported and/or braced, they are free to move with the structure to which they are attached without damaging adjoining components. Additionally, the connection to the structure is capable of accommodating the movement without failure. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.3)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

LF-3 Lens Covers. HR-not required; LS-not required; PR-H.	Lens covers on light fixtures are attached with safety devices. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.4)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
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### Cladding and Glazing

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CG-1 Cladding Anchors. HR-MH; LS-MH; PR-MH.	Cladding components weighing more than 10 lb/ft <sup>2</sup> (0.48 kN/m <sup>2</sup> ) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m) (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.1)			X		
CG-2 Cladding Isolation. HR-not required; LS-MH; PR-MH.	For steel or concrete moment-frame buildings, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.3)			X		
CG-3 Multi-Story Panels. HR-MH; LS-MH; PR-MH.	For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.4)			X		
CG-4 Threaded Rods. HR-not required; LS-MH; PR-MH.	Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.9)			X		
CG-5 Panel Connections. HR-MH; LS-MH; PR-MH.	Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.5)			X		

CG-6 Bearing Connections. HR-MH; LS-MH; PR-MH.	Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.6)			X		
CG-7 Inserts. HR-MH; LS-MH; PR-MH.	Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.7)			X		
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft <sup>2</sup> (1.5 m <sup>2</sup> ) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Tier 2: Sec. 13.6.1.5; Commentary: Sec. A.7.4.8)			X		

### Masonry Veneer

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft <sup>2</sup> (0.25 m <sup>2</sup> ), and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in. (914 mm); for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (610 mm). (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.1)			X		
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.2)			X		
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.3)			X		
M-4 Unreinforced Masonry Backup. HR-LMH; LS-LMH; PR-LMH.	There is no unreinforced masonry backup. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.2)			X		
M-5 Stud Tracks. HR-not required; LS-MH; PR-MH.	For veneer with coldformed steel stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. (610 mm) on center. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.)			X		
M-6 Anchorage. HR-not required; LS-MH; PR-MH.	For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.1)			X		

M-7 Weep Holes. HR-not required; LS-not required; PR-MH.	In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.6)			X		
M-8 Openings. HR-not required; LS-not required; PR-MH.	For veneer with cold-formed-steel stud backup, steel studs frame window and door openings. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.2)			X		

#### Parapets, Cornices, Ornamentation, and Appendages

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PCOA-1 URM Parapets or Cornices. HR-LMH; LS-LMH; PR-LMH.	Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.1)			X		
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft (3.0 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft (1.8 m). (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.2)			X		
PCOA-3 Concrete Parapets. HR-H; LS-MH; PR-LMH.	Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.3)			X		
PCOA-4 Appendages. HR-MH; LS-MH; PR-LMH.	Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft (1.8 m). This evaluation statement item does not apply to parapets or cornices covered by other evaluation statements. (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.4)			X		

#### Masonry Chimneys

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
MC-1 URM Chimneys. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.1)			X		

MC-2 Anchorage. HR-LMH; LS-LMH; PR-LMH.	Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.2)			X		
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### Stairs

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out of plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Tier 2: Sec. 13.6.2, 13.6.8; Commentary: Sec. A.7.10.1)			X		
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	The connection between the stairs and the structure does not rely on post-installed anchors in concrete or masonry, and the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.4.3.1 for moment-frame structures or 0.5 in. for all other structures without including any lateral stiffness contribution from the stairs. (Tier 2: Sec. 13.6.8; Commentary: Sec. A.7.10.2)			X		

### Contents and Furnishings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CF-1 Industrial Storage Racks. HR-LMH; LS-MH; PR-MH.	Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/RMI MH 16.1 as modified by ASCE 7, Chapter 15. (Tier 2: Sec. 13.8.1; Commentary: Sec. A.7.11.1)			X		
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Contents more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.2)				X	Tall narrow contents do not appear to be anchored to the structure or to each other. Contents more than six feet high should be anchored to provide overturning base restraint.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Equipment, stored items, or other contents weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level are braced or otherwise restrained. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.3)			X		
CF-4 Access Floors. HR-not required; LS-not required; PR-MH.	Access floors more than 9 in. (229 mm) high are braced. (Tier 2: Sec. 13.6.10; Commentary: Sec. A.7.11.4)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

CF-5 Equipment on Access Floors. HR-not required; LS-not required; PR-MH.	Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Tier 2: Sec. 13.7.7 13.6.10; Commentary: Sec. A.7.11.5)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
CF-6 Suspended Contents. HR-not required; LS-not required; PR-H.	Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.6)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

### Mechanical and Electrical Equipment

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Equipment weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level, and which is not in-line equipment, is braced. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.4)			X		
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Equipment installed in line with a duct or piping system, with an operating weight more than 75 lb (34.0 kg), is supported and laterally braced independent of the duct or piping system. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.5)				X	Mechanical equipment in-line with the duct or piping system weighing more than 75 pounds does not appear to be braced or restrained, but cannot be visually verified. This item requires further investigation to review vertical support and lateral bracing of equipment.
ME-3 Tall Narrow Equipment. HR-not required; LS-H; PR-MH.	Equipment more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.6)				X	Further investigation required to review anchorage of tall narrow equipment. All tall narrow mechanical equipment should be braced or anchored to the structure.
ME-4 Mechanical Doors. HR-not required; LS-not required; PR-MH.	Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 13.6.9; Commentary: Sec. A.7.12.7)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-5 Suspended Equipment. HR-not required; LS-not required; PR-H.	Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.8)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-6 Vibration Isolators. HR-not required; LS-not required; PR-H.	Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.9)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"



ME-7 Heavy Equipment. HR-not required; LS-not required; PR-H.	Floor supported or platform-supported equipment weighing more than 400 lb (181.4 kg) is anchored to the structure. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.10)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-8 Electrical Equipment. HR-not required; LS-not required; PR-H.	Electrical equipment is laterally braced to the structure. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.11)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-9 Conduit Couplings. HR-not required; LS-not required; PR-H.	Conduit greater than 2.5 in. (64 mm) trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Tier 2: Sec. 13.7.8; Commentary: Sec. A.7.12.12)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

### Piping

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PP-1 Flexible Couplings. HR-not required; LS-not required; PR-H.	Fluid and gas piping has flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.2)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-2 Fluid and Gas Piping. HR-not required; LS-not required; PR-H.	Fluid and gas piping is anchored and braced to the structure to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-3 C-Clamps. HR-not required; LS-not required; PR-H.	One-sided C-clamps that support piping larger than 2.5 in. (64 mm) in diameter are restrained. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.5)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-4 Piping Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.6)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

### Ducts

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
D-1 Duct Bracing. HR-not required; LS-not required; PR-H.	Rectangular ductwork larger than 6 ft <sup>2</sup> (0.56 m <sup>2</sup> ) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft (9.2 m). The maximum spacing of longitudinal bracing does not exceed 60 ft (18.3 m). (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.2)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
D-2 Duct Support. HR-not required; LS-not required; PR-H.	Ducts are not supported by piping or electrical conduit. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.3)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"

D-3 Ducts Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.4)			X		N/A due to ASCE 41 Performance Level: "Life Safety (LS)"
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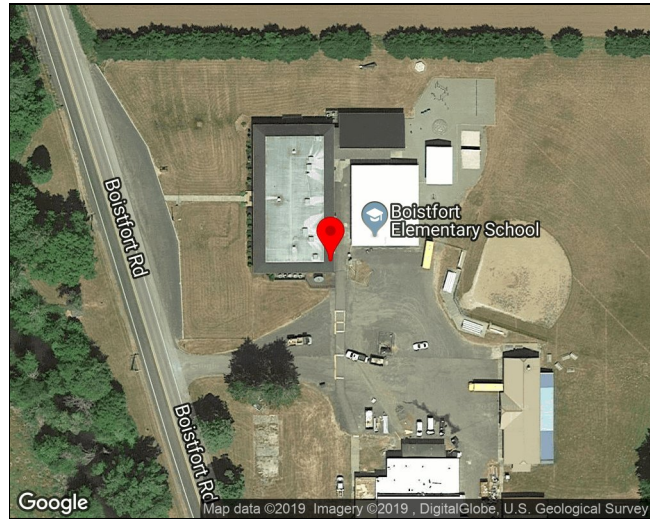
#### Elevators

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
EL-1 Retainer Guards. HR-not required; LS-H; PR-H.	Sheaves and drums have cable retainer guards. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.1)			X		Non-applicable due to ASCE 41 Seismicity Level: "Moderate"
EL-2 Retainer Plate. HR-not required; LS-H; PR-H.	A retainer plate is present at the top and bottom of both car and counterweight. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.2)			X		Non-applicable due to ASCE 41 Seismicity Level: "Moderate"
EL-3 Elevator Equipment. HR-not required; LS-not required; PR-H.	Equipment, piping, and other components that are part of the elevator system are anchored. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.3)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"
EL-4 Seismic Switch. HR-not required; LS-not required; PR-H.	Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.4)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"
EL-5 Shaft Walls. HR-not required; LS-not required; PR-H.	Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.5)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"
EL-6 Counterweight Rails. HR-not required; LS-not required; PR-H.	All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.6)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"
EL-7 Brackets. HR-not required; LS-not required; PR-H.	The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.7)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"
EL-8 Spreader Bracket. HR-not required; LS-not required; PR-H.	Spreader brackets are not used to resist seismic forces. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.8)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"
EL-9 Go-Slow Elevators. HR-not required; LS-not required; PR-H.	The building has a go-slow elevator system. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.9)			X		Non-applicable due to ASCE 41 Performance "Level: Life Safety (LS)"

# 1. Boistfort, Boistfort Elementary, Main Building

## 1.1 Building Description

Building Name:	Main Building
Facility Name:	Boistfort Elementary
District Name:	Boistfort
ICOS Latitude:	46.55
ICOS Longitude:	-123.133
ICOS	
County/District ID:	21234
ICOS Building ID:	18408
ASCE 41 Bldg Type:	URM
Enrollment:	99
Gross Sq. Ft. :	18,935
Year Built:	1936
Number of Stories:	1
S <sub>XS</sub> BSE-2E:	0.948
S <sub>X1</sub> BSE-2E:	0.610
ASCE 41 Level of Seismicity:	High
Site Class:	D
V <sub>S30</sub> (m/s):	320
Liquefaction Potential:	Moderate to High
Tsunami Risk:	None
Structural Drawings Available:	Yes
Evaluating Firm:	WRK Engineers



The Boistfort Elementary School main building is a one-story unreinforced masonry structure with a CMU addition and a wood-framed mezzanine. The building is constructed on level ground and is located in Curtis, Washington. The 1936 building is 154 feet by 83 feet with a maximum roof height of 25 feet. Building construction consists of unreinforced brick walls in the main building and concrete block walls in the addition. The floor system is a wood-framed system below a finished floor. The roof system is a wood-framed system with a straight-sheathed diaphragm. The building shares a site with the gym, a play shed, and various outbuildings.

### 1.1.1 Building Use

The Boistfort Elementary School main building includes classrooms, a playroom, a kitchen, and storage. The PK-8 elementary school has over 90 student occupants.

### 1.1.2 Structural System

**Table 1.1-1. Structural System Description of Boistfort Elementary**

<b>Structural System</b>	<b>Description</b>
Structural Roof	The roof system is composed of wood joists and wood trusses with a straight-sheathed roof diaphragm.
Structural Floor(s)	The lower main level and the addition have a concrete floor slab. The main level and the mezzanine level are wood-framed systems.
Foundations	The masonry walls are supported by continuous wall footings. The floor system is supported by wood girders resting on concrete posts and spread footings.
Gravity System	The gravity system is composed of wood trusses and joists, wood girders and posts, wood stud walls, and masonry walls.
Lateral System	The lateral system is a mixture of wood shear walls between the attic floor and roof, unreinforced masonry walls, and reinforced concrete block walls.

### 1.1.3 Structural System Visual Condition

**Table 1.1-2. Structural System Condition Description of Boistfort Elementary**

<b>Structural System</b>	<b>Description</b>
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Structural Floor(s)	No visible signs of corrosion, damage, or deterioration.
Foundations	Unknown.
Gravity System	No visible signs of corrosion, damage, or deterioration.
Lateral System	No visible signs of corrosion, damage, or deterioration.

## 1.2 Seismic Evaluation Findings

### 1.2.1 Structural Seismic Deficiencies

The structural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation.

**Table 1-3. Identified Structural Seismic Deficiencies for Boistfort Boistfort Elementary Main Building**

Deficiency	Description
Load Path	Incomplete structural drawings/details available. Unknown transfer to CMU shear walls and no foundation dowels. Post-installed anchors and FRP may be appropriate to provide a load path.
Adjacent Buildings	No seismic gap between main building and CMU addition. New shear walls may be appropriate to reduce building drift. Further investigation is required.
Mezzanines	There is no transfer between wood shear walls at the mezzanine level and the main floor. Lateral system strengthening or addition of new shear walls may be appropriate to mitigate seismic risk.
Vertical Irregularities	Vertical elements resisting shear wall overturning are discontinuous between the attic and the main level. Lateral system strengthening or addition of new shear walls may be appropriate to mitigate seismic risk.
Shear Stress Check	Pseudo shear stress is greater than 30 psi. The building likely requires URM shear wall strengthening or the addition of new shear walls. Further investigation is required.
Wall Anchorage	Out-of-plane wall anchorage is not present. Tension ties, blocking, strapping, and diaphragm nailing is required along the URM walls.
Wood Ledgers	This evaluation item is likely non-compliant due to the building's age, but could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Transfer to Shear Walls	Wall anchorage between diaphragms and URM shear walls not present for transfer of seismic forces to the shear walls. Post-installed anchors recommended to connect the diaphragm to the URM shear walls.
Proportions	The height-to-thickness ratio of the URM shear walls at each story is greater than 13 (12-foot height/9-inch thickness). URM out-of-plane strengthening is likely required. The addition of steel strongbacks may be appropriate to strengthen the URM walls. Further investigation is required.
Cross Ties	The building does not have continuous cross ties between diaphragm chords. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of new cross ties between diaphragm chords or the addition of strap plates to connect existing framing members together.
Straight Sheathing	Straight-sheathed diaphragms have aspect ratios greater than 2-to-1. Diaphragm strengthening, including the addition of wood structural panel sheathing, may be appropriate to mitigate seismic risk.
Spans	Wood diaphragms do not consist of wood structural panels or diagonal sheathing. Installation of wood structural panels may be appropriate to mitigate seismic risk.
Diagonally Sheathed and Unblocked Diaphragms	This evaluation item cannot be visually verified, but is likely non-compliant. This item requires further investigation to make a final determination on its compliance. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of diaphragm blocking and additional nailing.
Beam	Girder, and Truss Supports, Beams, girders, and trusses supported by URM walls or pilasters do not have independent secondary columns for support of vertical loads. Addition of secondary support is recommended.

### 1.2.2 Structural Checklist Items Marked as 'U'nknown

Where building structural component seismic adequacy was unknown due to lack of available information or limited observation, the structural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown structural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

**Table 1-4. Identified Structural Checklist Items Marked as Unknown for Boistfort Boistfort Elementary Main Building**

Unknown Item	Description
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. Moderate to high liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Girder-Column Connection	This evaluation item is unknown and could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Masonry Layup	This evaluation item is unknown and cannot be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Stiffness of Wall Anchors	This evaluation item is unknown and could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

### 1.3.1 Nonstructural Seismic Deficiencies

The nonstructural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation. Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

**Table 1-5. Identified Nonstructural Seismic Deficiencies for Boistfort Boistfort Elementary Main Building**

Deficiency	Description
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping/ductwork is not adequately protected from damage that could potentially allow the release of hazardous material. Hazardous material piping should be braced to the structure.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Flexible couplings not noted on hazardous material piping/ductwork. The installation of shutoff valves may be appropriate to limit hazardous material spills.
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	Inadequate bracing for URM partitions. URM partitions should be braced at a maximum spacing of six feet.
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Inadequate attachments for suspended ceilings. Add ceiling attachment at twelve feet spacing in each direction.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Inadequate attachments for suspended ceilings. Add ceiling attachment at twelve feet spacing in each direction.
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	Inadequate independent attachments for light fixtures. Add seismic bracing to all light fixtures in grid ceiling suspension systems.
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Greater than 6'-0" spacing. Add additional anchors, as required, to ensure a maximum of six feet spacing between anchors.
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Anchorage required for tall narrow contents greater than six feet high to provide overturning restraint.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Anchorage required for fall-prone contents. Heavy items on upper shelves should be restrained by netting or cabling to avoid becoming falling hazards.
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Independent vertical support and lateral bracing is required for in-line equipment.

### 1.3.2 Nonstructural Checklist Items Marked as 'U'known

Where building nonstructural component seismic adequacy was unknown due to lack of available information or limited observation, the nonstructural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown nonstructural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

**Table 1-6. Identified Nonstructural Checklist Items Marked as Unknown for Boistfort Boistfort Elementary Main Building**

Unknown Item	Description
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Emergency power equipment was not observed. Based on the age of the building, emergency power is likely non-existent or non-compliant. Further investigation is required to review the life-safety system anchorage and bracing.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	Further investigation is required to locate shutoff valves or spill/leak protection for hazardous material piping. Based on the age of the building, shutoff valves are likely non-existent or non-compliant. The installation of shutoff valves may be appropriate to limit hazardous material spills.
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	This evaluation item is unknown and likely non-compliant due to the building's age. This item requires further investigation to make a final determination on its compliance.
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Further investigation required to verify detailing of masonry veneer ties.
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Further investigation required to verify method of support of masonry veneer at each floor above grade.
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Further investigation required to verify anchorage of masonry veneer at weakened planes.
M-6 Anchorage. HR-not required; LS-MH; PR-MH.	Further investigation required to verify anchorage of masonry veneer.



Photos:



Figure 1-1. Storage Room at the CMU Addition. Original Unreinforced Masonry Wall Shown on Left.



Figure 1-2. Library at Lower Main Level



**Figure 1-3. Wall Space Showing Straight-Sheathed Walls**





**Figure 1-4. Unbraced Ducts and Piping in Attic Space**



**Figure 1-5. New Plywood Shear Walls in Attic Discontinuous to Foundation**



**Figure 1-6. Connection of Roof Diaphragm to Plywood Shear Wall Likely Inadequate**



**Figure 1-7. Lack of Connection from Roof Diaphragm to Masonry Walls**





**Figure 1-8. Boistfort Elementary School - West Exterior**



**Figure 1-9. CMU Addition - East Exterior**



**Figure 1-10. Unbraced Tall Narrow Contents, Typical**

## Boistfort, Boistfort Elementary, Main Building

### 17-2 Collapse Prevention Basic Configuration Checklist

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

#### Low Seismicity

##### Building System - General

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Load Path	The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Tier 2: Sec. 5.4.1.1; Commentary: Sec. A.2.1.10)		X			Incomplete structural drawings/details available. Unknown transfer to CMU shear walls and no foundation dowels. Post-installed anchors and FRP may be appropriate to provide a load path.
Adjacent Buildings	The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Tier 2: Sec. 5.4.1.2; Commentary: Sec. A.2.1.2)		X			No seismic gap between main building and CMU addition. New shear walls may be appropriate to reduce building drift. Further investigation is required.
Mezzanines	Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Tier 2: Sec. 5.4.1.3; Commentary: Sec. A.2.1.3)		X			There is no transfer between wood shear walls at the mezzanine level and the main floor. Lateral system strengthening or addition of new shear walls may be appropriate to mitigate seismic risk.

##### Building System - Building Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Weak Story	The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Tier 2: Sec. 5.4.2.1; Commentary: Sec. A.2.2.2)			X		
Soft Story	The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Tier 2: Sec. 5.4.2.2; Commentary: Sec. A.2.2.3)			X		

Vertical Irregularities	All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Tier 2: Sec. 5.4.2.3; Commentary: Sec. A.2.2.4)		X			Vertical elements resisting shear wall overturning are discontinuous between the attic and the main level. Lateral system strengthening or addition of new shear walls may be appropriate to mitigate seismic risk.
Geometry	There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 5.4.2.4; Commentary: Sec. A.2.2.5)			X		
Mass	There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 5.4.2.5; Commentary: Sec. A.2.2.6)			X		
Torsion	The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Tier 2: Sec. 5.4.2.6; Commentary: Sec. A.2.2.7)	X				

### **Moderate Seismicity** (Complete the Following Items in Addition to the Items for Low Seismicity)

#### **Geologic Site Hazards**

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Liquefaction	Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.1)				X	The liquefaction potential of site soils is unknown at this time given available information. Moderate to high liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.2)				X	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.



Surface Fault Rupture	Surface fault rupture and surface displacement at the building site are not anticipated. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.3)				X	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
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## High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)

### Foundation Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Overturning	The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6Sa. (Tier 2: Sec. 5.4.3.3; Commentary: Sec. A.6.2.1)	X				
Ties Between Foundation Elements	The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Tier 2: Sec. 5.4.3.4; Commentary: Sec. A.6.2.2)	X				

## 17-36 Collapse Prevention Structural Checklist for Building Types URM and URMa

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

### Low and Moderate Seismicity

#### Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Redundancy	The number of lines of shear walls in each principal direction is greater than or equal to 2. (Tier 2: Sec. 5.5.1.1; Commentary: Sec. A.3.2.1.1)	X				
Shear Stress Check	The shear stress in the unreinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 30 lb/in.2 (0.21 MPa) for clay units and 70 lb/in.2 (0.48 MPa) for concrete units. (Tier 2: Sec. 5.5.3.1.1; Commentary: Sec. A.3.2.5.1)		X			Pseudo shear stress is greater than 30 psi. The building likely requires URM shear wall strengthening or the addition of new shear walls. Further investigation is required.

#### Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Wall Anchorage	Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Tier 2: Sec. 5.7.1.1; Commentary: Sec. A.5.1.1)		X			Out-of-plane wall anchorage is not present. Tension ties, blocking, strapping, and diaphragm nailing is required along the URM walls.
Wood Ledgers	The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 5.7.1.3; Commentary: Sec. A.5.1.2)		X			This evaluation item is likely non-compliant due to the building's age, but could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

Transfer to Shear Walls	Diaphragms are connected for transfer of seismic forces to the shear walls. (Tier 2: Sec. 5.7.2; Commentary: Sec. A.5.2.1)		X			Wall anchorage between diaphragms and URM shear walls not present for transfer of seismic forces to the shear walls. Post-installed anchors recommended to connect the diaphragm to the URM shear walls.
Girder-Column Connection	There is a positive connection using plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 5.7.4.1; Commentary: Sec. A.5.4.1)				X	This evaluation item is unknown and could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

## High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)

### Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Proportions	The height-to-thickness ratio of the shear walls at each story is less than the following: Top story of multi-story building – 9; First story of multi-story building – 15; All other conditions – 13. (Tier 2: Sec. 5.5.3.1.2; Commentary: Sec. A.3.2.5.2)		X			The height-to-thickness ratio of the URM shear walls at each story is greater than 13 (12-foot height/9-inch thickness). URM out-of-plane strengthening is likely required. The addition of steel strongbacks may be appropriate to strengthen the URM walls. Further investigation is required.
Masonry Layup	Filled collar joints of multi-wythe masonry walls have negligible voids. (Tier 2: Sec. 5.5.3.4.1; Commentary: Sec. A.3.2.5.3)				X	This evaluation item is unknown and cannot be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.

### Diaphragms (Stiff or Flexible)

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Openings at Shear Walls	Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.4)			X		

Openings at Exterior Masonry Shear Walls	Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.6)			X		
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### Flexible Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Cross Ties	There are continuous cross ties between diaphragm chords. (Tier 2: Sec. 5.6.1.2; Commentary: Sec. A.4.1.2)		X			The building does not have continuous cross ties between diaphragm chords. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of new cross ties between diaphragm chords or the addition of strap plates to connect existing framing members together.
Straight Sheathing	All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.1)		X			Straight-sheathed diaphragms have aspect ratios greater than 2-to-1. Diaphragm strengthening, including the addition of wood structural panel sheathing, may be appropriate to mitigate seismic risk.
Spans	All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.2)		X			Wood diaphragms do not consist of wood structural panels or diagonal sheathing. Installation of wood structural panels may be appropriate to mitigate seismic risk.
Diagonally Sheathed and Unblocked Diaphragms	All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4 to-1. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.3)		X			This evaluation item cannot be visually verified, but is likely non-compliant. This item requires further investigation to make a final determination on its compliance. Diaphragm strengthening may be appropriate to mitigate seismic risk through the addition of diaphragm blocking and additional nailing.
Other Diaphragms	The diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 5.6.5; Commentary: Sec. A.4.7.1)	X				

## Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Stiffness of Wall Anchors	Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors. (Tier 2: Sec. 5.7.1.2; Commentary: Sec. A.5.1.4)				X	This evaluation item is unknown and could not be visually verified. This item requires further field investigation to make a final determination on its compliance and to develop a mitigation recommendation, if necessary.
Beam, Girder, and Truss Supports	Beams, girders, and trusses supported by unreinforced masonry walls or pilasters have independent secondary columns for support of vertical loads. (Tier 2: Sec. 5.7.4.4; Commentary: Sec. A.5.4.5)		X			Beams, girders, and trusses supported by URM walls or pilasters do not have independent secondary columns for support of vertical loads. Addition of secondary support is recommended.

## Boistfort, Boistfort Elementary, Main Building

### 17-38 Nonstructural Checklist

Notes:

C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Performance Level: HR = Hazards Reduced, LS = Life Safety, and PR = Position Retention.

Level of Seismicity: L = Low, M = Moderate, and H = High

#### Life Safety Systems

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LSS-1 Fire Suppression Piping. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping is anchored and braced in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.1)			X		
LSS-2 Flexible Couplings. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping has flexible couplings in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.2)			X		
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Equipment used to power or control Life Safety systems is anchored or braced. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.1)				X	Emergency power equipment was not observed. Based on the age of the building, emergency power is likely non-existent or non-compliant. Further investigation is required to review the life-safety system anchorage and bracing.
LSS-4 Stair and Smoke Ducts. HR-not required; LS-LMH; PR-LMH.	Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.1)			X		
LSS-5 Sprinkler Ceiling Clearance. HR-not required; LS-MH; PR-MH.	Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.3)			X		
LSS-6 Emergency Lighting. HR-not required; LS-not required; PR-LMH	Emergency and egress lighting equipment is anchored or braced. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.1)			X		

#### Hazardous Materials

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
HM-1 Hazardous Material Equipment. HR-LMH; LS-LMH; PR-LMH.	Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.2)			X		

HM-2 Hazardous Material Storage. HR-LMH; LS-LMH; PR-LMH.	Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 13.8.3; Commentary: Sec. A.7.15.1)			X		
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)		X			Piping/ductwork is not adequately protected from damage that could potentially allow the release of hazardous material. Hazardous material piping should be braced to the structure.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	Piping containing hazardous material, including natural gas, has shutoff valves or other devices to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.3)				X	Further investigation is required to locate shutoff valves or spill/leak protection for hazardous material piping. Based on the age of the building, shutoff valves are likely non-existent or non-compliant. The installation of shutoff valves may be appropriate to limit hazardous material spills.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Hazardous material ductwork and piping, including natural gas piping, have flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.15.4)		X			Flexible couplings not noted on hazardous material piping/ductwork. The installation of shutoff valves may be appropriate to limit hazardous material spills.
HM-6 Piping or Ducts Crossing Seismic Joints. HR-MH; LS-MH; PR-MH.	Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5, 13.7.6; Commentary: Sec. A.7.13.6)			X		

### Partitions

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft (3.0 m) in Low or Moderate Seismicity, or at most 6 ft (1.8 m) in High Seismicity. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.1)		X			Inadequate bracing for URM partitions. URM partitions should be braced at a maximum spacing of six feet.

P-2 Heavy Partitions Supported by Ceilings. HR-LMH; LS-LMH; PR-LMH.	The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		
P-3 Drift. HR-not required; LS-MH; PR-MH.	Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.2)			X		
P-4 Light Partitions Supported by Ceilings. HR-not required; LS-not required; PR-MH.	The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
P-5 Structural Separations. HR-not required; LS-not required; PR-MH.	Partitions that cross structural separations have seismic or control joints. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
P-6 Tops. HR-not required; LS-not required; PR-MH.	The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft (1.8 m). (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

#### Ceilings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft <sup>2</sup> (1.1 m <sup>2</sup> ) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)		X			Inadequate attachments for suspended ceilings. Add ceiling attachment at twelve feet spacing in each direction.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft <sup>2</sup> (1.1 m <sup>2</sup> ) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)		X			Inadequate attachments for suspended ceilings. Add ceiling attachment at twelve feet spacing in each direction.
C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft <sup>2</sup> (13.4 m <sup>2</sup> ) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"



C-4 Edge Clearance. HR-not required; LS-not required; PR-MH.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft <sup>2</sup> (13.4 m <sup>2</sup> ) have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in. (13 mm); in High Seismicity, 3/4 in. (19 mm). (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
C-5 Continuity Across Structure Joints. HR-not required; LS-not required; PR-MH.	The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
C-6 Edge Support. HR-not required; LS-not required; PR-H.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft <sup>2</sup> (13.4 m <sup>2</sup> ) are supported by closure angles or channels not less than 2 in. (51 mm) wide. (Tier 2: Sec. 13.6.4 ; Commentary: Sec. A.7.2.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
C-7 Seismic Joints. HR-not required; LS-not required; PR-H.	Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2,500 ft <sup>2</sup> (232.3 m <sup>2</sup> ) and has a ratio of long-to-short dimension no more than 4-to-1. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.7)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

#### Light Fixtures

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Tier 2: Sec. 13.6.4, 13.7.9; Commentary: Sec. A.7.3.2)		X			Inadequate independent attachments for light fixtures. Add seismic bracing to all light fixtures in grid ceiling suspension systems.
LF-2 Pendant Supports. HR-not required; LS-not required; PR-H.	Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft. Unbraced suspended fixtures are free to allow a 360-degree range of motion at an angle not less than 45 degrees from horizontal without contacting adjacent components. Alternatively, if rigidly supported and/or braced, they are free to move with the structure to which they are attached without damaging adjoining components. Additionally, the connection to the structure is capable of accommodating the movement without failure. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
LF-3 Lens Covers. HR-not required; LS-not required; PR-H.	Lens covers on light fixtures are attached with safety devices. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

## Cladding and Glazing

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CG-1 Cladding Anchors. HR-MH; LS-MH; PR-MH.	Cladding components weighing more than 10 lb/ft <sup>2</sup> (0.48 kN/m <sup>2</sup> ) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m) (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.1)			X		
CG-2 Cladding Isolation. HR-not required; LS-MH; PR-MH.	For steel or concrete moment-frame buildings, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.3)			X		
CG-3 Multi-Story Panels. HR-MH; LS-MH; PR-MH.	For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.4)			X		
CG-4 Threaded Rods. HR-not required; LS-MH; PR-MH.	Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.9)			X		
CG-5 Panel Connections. HR-MH; LS-MH; PR-MH.	Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.5)			X		

CG-6 Bearing Connections. HR-MH; LS-MH; PR-MH.	Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.6)			X		
CG-7 Inserts. HR-MH; LS-MH; PR-MH.	Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.7)			X		
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft <sup>2</sup> (1.5 m <sup>2</sup> ) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Tier 2: Sec. 13.6.1.5; Commentary: Sec. A.7.4.8)				X	This evaluation item is unknown and likely non-compliant due to the building's age. This item requires further investigation to make a final determination on its compliance.

### Masonry Veneer

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft <sup>2</sup> (0.25 m <sup>2</sup> ), and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in. (914 mm); for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (610 mm). (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.1)				X	Further investigation required to verify detailing of masonry veneer ties.
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.2)				X	Further investigation required to verify method of support of masonry veneer at each floor above grade.
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.3)				X	Further investigation required to verify anchorage of masonry veneer at weakened planes.
M-4 Unreinforced Masonry Backup. HR-LMH; LS-LMH; PR-LMH.	There is no unreinforced masonry backup. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.2)	X				
M-5 Stud Tracks. HR-not required; LS-MH; PR-MH.	For veneer with coldformed steel stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. (610 mm) on center. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.)			X		

M-6 Anchorage. HR-not required; LS-MH; PR-MH.	For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.1)				X	Further investigation required to verify anchorage of masonry veneer.
M-7 Weep Holes. HR-not required; LS-not required; PR-MH.	In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
M-8 Openings. HR-not required; LS-not required; PR-MH.	For veneer with cold-formed-steel stud backup, steel studs frame window and door openings. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

#### Parapets, Cornices, Ornamentation, and Appendages

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PCOA-1 URM Parapets or Cornices. HR-LMH; LS-LMH; PR-LMH.	Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.1)			X		
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft (3.0 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft (1.8 m). (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.2)		X			Greater than 6'-0" spacing. Add additional anchors, as required, to ensure a maximum of six feet spacing between anchors.
PCOA-3 Concrete Parapets. HR-H; LS-MH; PR-LMH.	Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.3)			X		
PCOA-4 Appendages. HR-MH; LS-MH; PR-LMH.	Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft (1.8 m). This evaluation statement item does not apply to parapets or cornices covered by other evaluation statements. (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.4)			X		

### Masonry Chimneys

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
MC-1 URM Chimneys. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.1)			X		
MC-2 Anchorage. HR-LMH; LS-LMH; PR-LMH.	Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.2)			X		

### Stairs

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out of plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Tier 2: Sec. 13.6.2, 13.6.8; Commentary: Sec. A.7.10.1)			X		
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	The connection between the stairs and the structure does not rely on post-installed anchors in concrete or masonry, and the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.4.3.1 for moment-frame structures or 0.5 in. for all other structures without including any lateral stiffness contribution from the stairs. (Tier 2: Sec. 13.6.8; Commentary: Sec. A.7.10.2)			X		

### Contents and Furnishings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CF-1 Industrial Storage Racks. HR-LMH; LS-MH; PR-MH.	Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/RMI MH 16.1 as modified by ASCE 7, Chapter 15. (Tier 2: Sec. 13.8.1; Commentary: Sec. A.7.11.1)			X		
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Contents more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.2)		X			Anchorage required for tall narrow contents greater than six feet high to provide overturning restraint.

CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Equipment, stored items, or other contents weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level are braced or otherwise restrained. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.3)		X			Anchorage required for fall-prone contents. Heavy items on upper shelves should be restrained by netting or cabling to avoid becoming falling hazards.
CF-4 Access Floors. HR-not required; LS-not required; PR-MH.	Access floors more than 9 in. (229 mm) high are braced. (Tier 2: Sec. 13.6.10; Commentary: Sec. A.7.11.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
CF-5 Equipment on Access Floors. HR-not required; LS-not required; PR-MH.	Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Tier 2: Sec. 13.7.7 13.6.10; Commentary: Sec. A.7.11.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
CF-6 Suspended Contents. HR-not required; LS-not required; PR-H.	Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

#### Mechanical and Electrical Equipment

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Equipment weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level, and which is not in-line equipment, is braced. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.4)			X		
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Equipment installed in line with a duct or piping system, with an operating weight more than 75 lb (34.0 kg), is supported and laterally braced independent of the duct or piping system. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.5)		X			Independent vertical support and lateral bracing is required for in-line equipment.
ME-3 Tall Narrow Equipment. HR-not required; LS-H; PR-MH.	Equipment more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.6)			X		
ME-4 Mechanical Doors. HR-not required; LS-not required; PR-MH.	Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 13.6.9; Commentary: Sec. A.7.12.7)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-5 Suspended Equipment. HR-not required; LS-not required; PR-H.	Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.8)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-6 Vibration Isolators. HR-not required; LS-not required; PR-H.	Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.9)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

ME-7 Heavy Equipment. HR-not required; LS-not required; PR-H.	Floor supported or platform-supported equipment weighing more than 400 lb (181.4 kg) is anchored to the structure. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.10)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-8 Electrical Equipment. HR-not required; LS-not required; PR-H.	Electrical equipment is laterally braced to the structure. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.11)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
ME-9 Conduit Couplings. HR-not required; LS-not required; PR-H.	Conduit greater than 2.5 in. (64 mm) trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Tier 2: Sec. 13.7.8; Commentary: Sec. A.7.12.12)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

### Piping

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PP-1 Flexible Couplings. HR-not required; LS-not required; PR-H.	Fluid and gas piping has flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-2 Fluid and Gas Piping. HR-not required; LS-not required; PR-H.	Fluid and gas piping is anchored and braced to the structure to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-3 C-Clamps. HR-not required; LS-not required; PR-H.	One-sided C-clamps that support piping larger than 2.5 in. (64 mm) in diameter are restrained. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
PP-4 Piping Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

### Ducts

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
D-1 Duct Bracing. HR-not required; LS-not required; PR-H.	Rectangular ductwork larger than 6 ft <sup>2</sup> (0.56 m <sup>2</sup> ) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft (9.2 m). The maximum spacing of longitudinal bracing does not exceed 60 ft (18.3 m). (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.2)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
D-2 Duct Support. HR-not required; LS-not required; PR-H.	Ducts are not supported by piping or electrical conduit. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

D-3 Ducts Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
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#### Elevators

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
EL-1 Retainer Guards. HR-not required; LS-H; PR-H.	Sheaves and drums have cable retainer guards. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.1)			X		
EL-2 Retainer Plate. HR-not required; LS-H; PR-H.	A retainer plate is present at the top and bottom of both car and counterweight. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.2)			X		
EL-3 Elevator Equipment. HR-not required; LS-not required; PR-H.	Equipment, piping, and other components that are part of the elevator system are anchored. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.3)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
EL-4 Seismic Switch. HR-not required; LS-not required; PR-H.	Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.4)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
EL-5 Shaft Walls. HR-not required; LS-not required; PR-H.	Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.5)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
EL-6 Counterweight Rails. HR-not required; LS-not required; PR-H.	All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.6)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
EL-7 Brackets. HR-not required; LS-not required; PR-H.	The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.7)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
EL-8 Spreader Bracket. HR-not required; LS-not required; PR-H.	Spreader brackets are not used to resist seismic forces. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.8)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"
EL-9 Go-Slow Elevators. HR-not required; LS-not required; PR-H.	The building has a go-slow elevator system. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.9)			X		Non-applicable due to ASCE 41 Performance Level: "Life Safety (LS)"

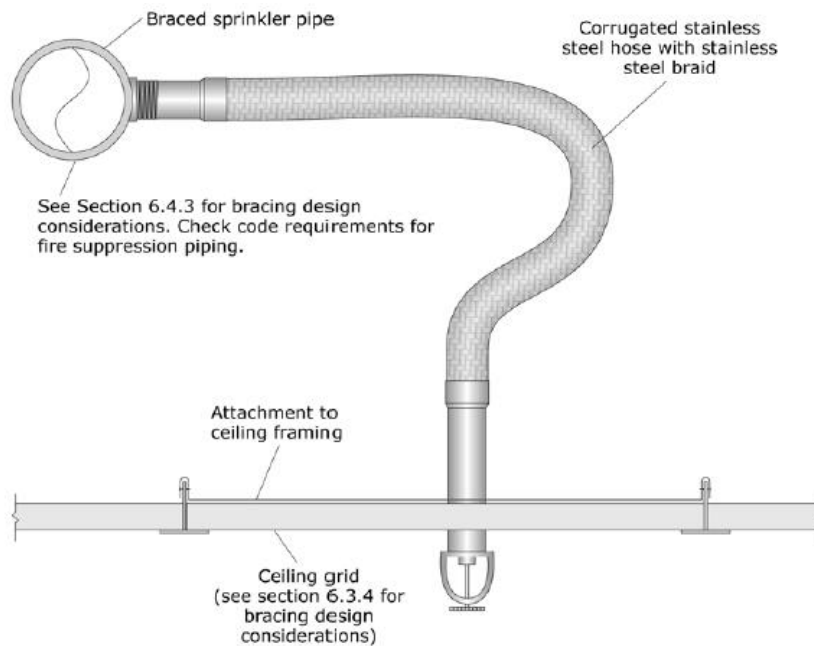


## **FEMA E-74 Nonstructural Seismic Bracing Excerpts**

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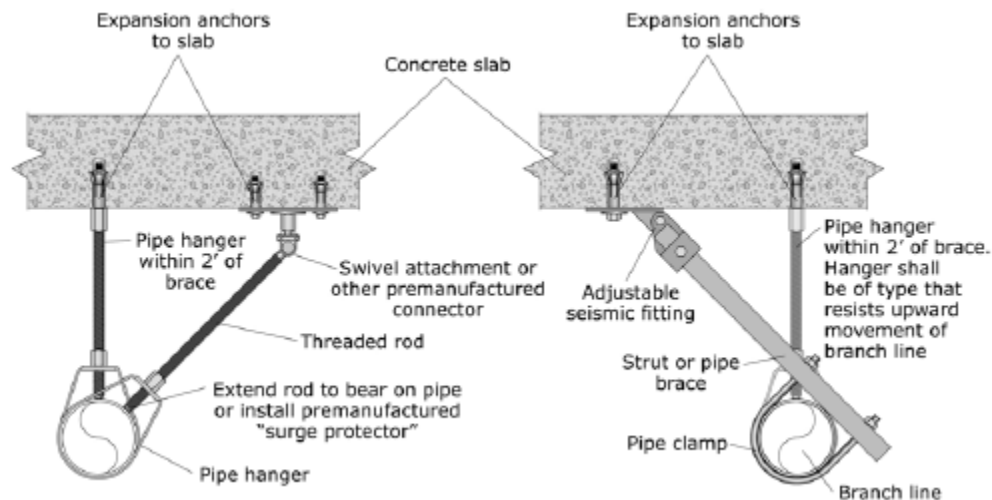
## Life Safety Systems



**Note:** for seismic design category D, E & F, the flexible sprinkler hose fitting must accommodate at least 1" of ceiling movement without use of an oversized opening. Alternatively, the sprinkler head must have a 2" oversize ring or adapter that allows 1" movement in all directions.

**Figure G-1. Flexible Sprinkler Drop.**

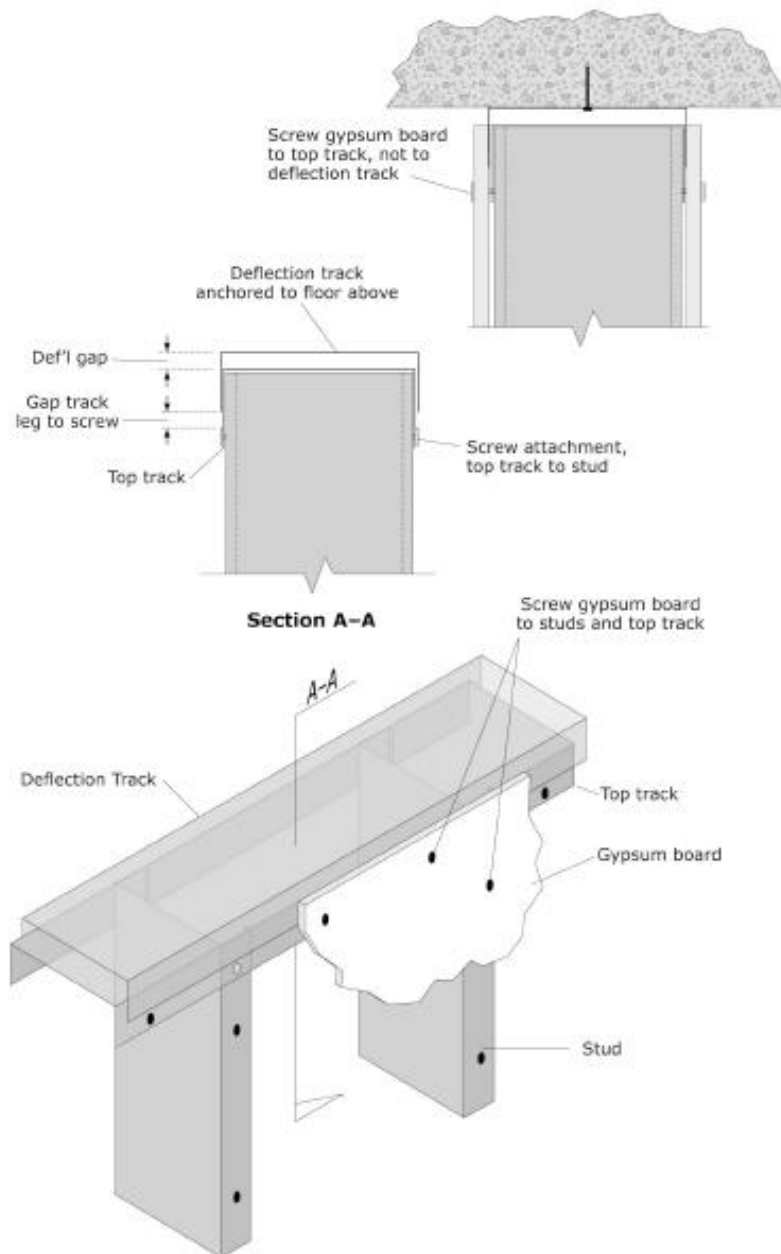
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



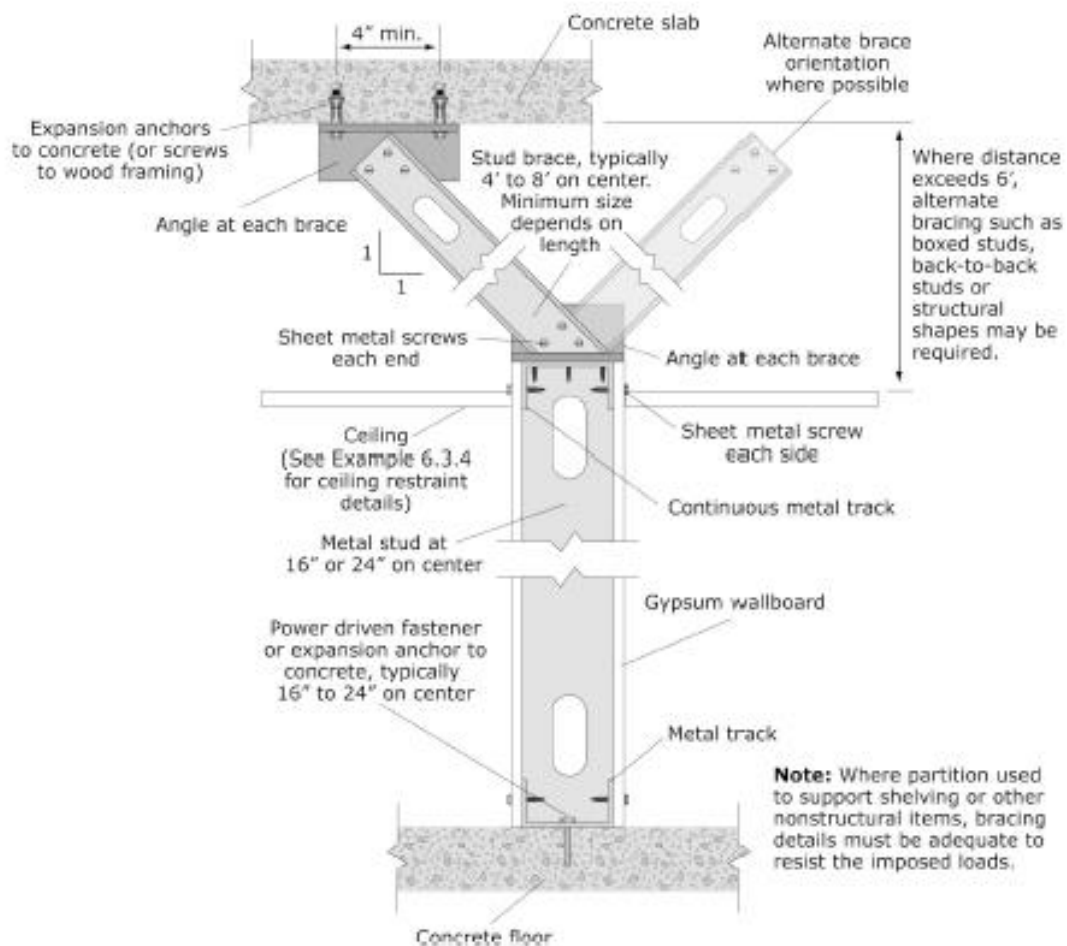
**Figure G-2. End of Line Restraint.**

*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

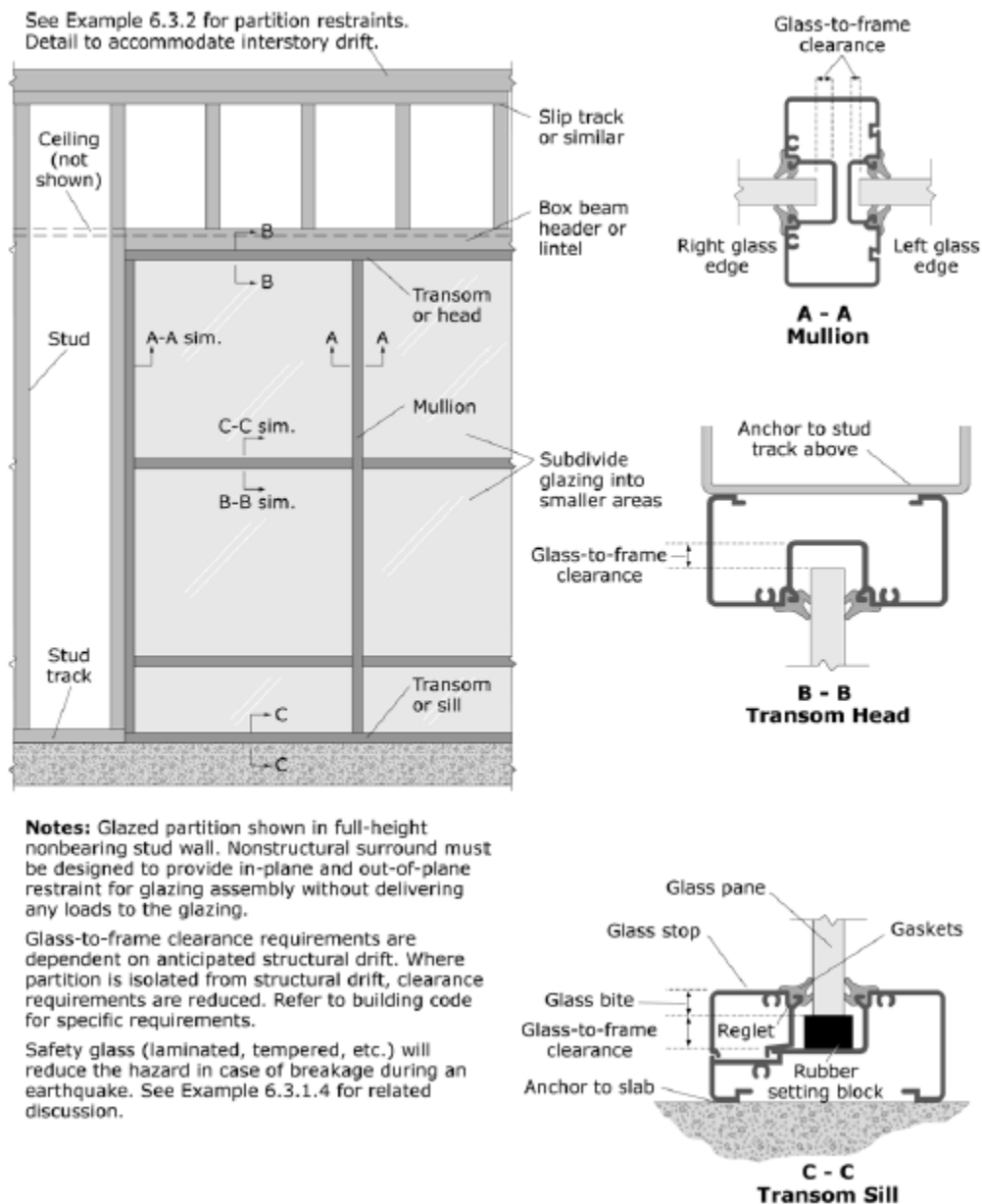
## Partitions



**Figure G-3. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)

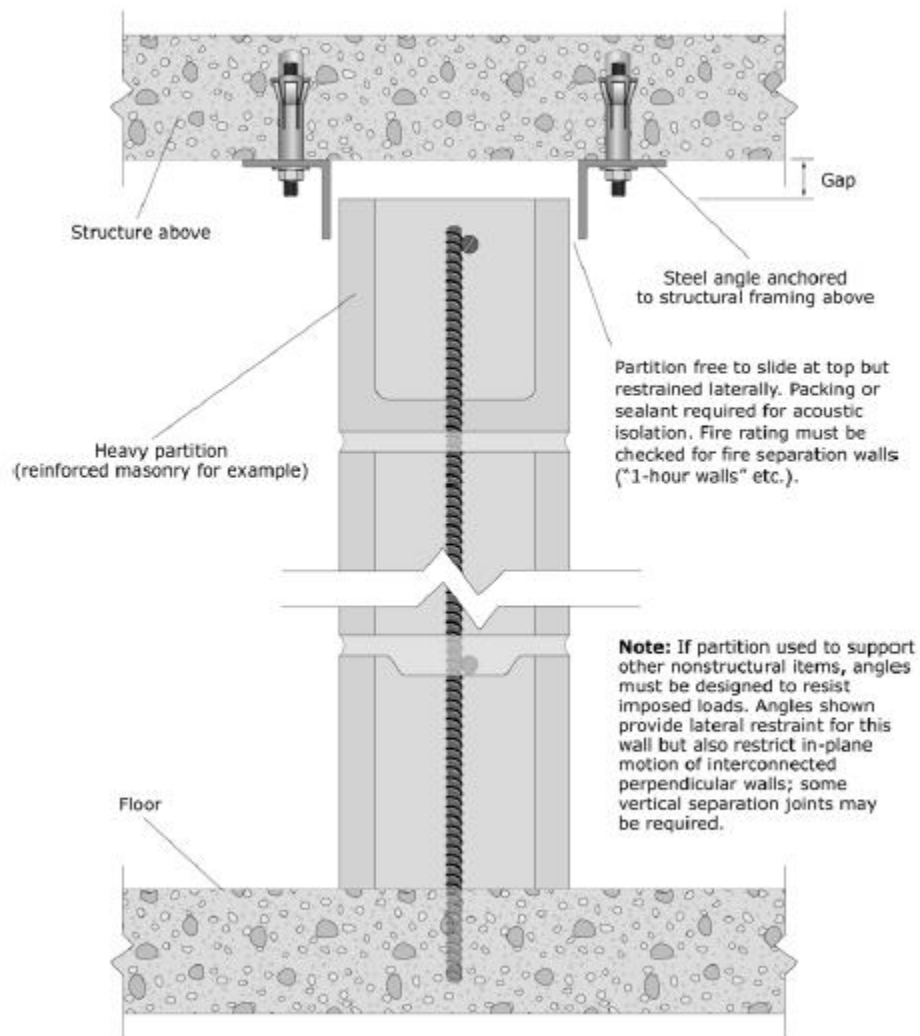


**Figure G-4. Mitigation Schemes for Bracing the Tops of Metal Stud Partition Walls.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

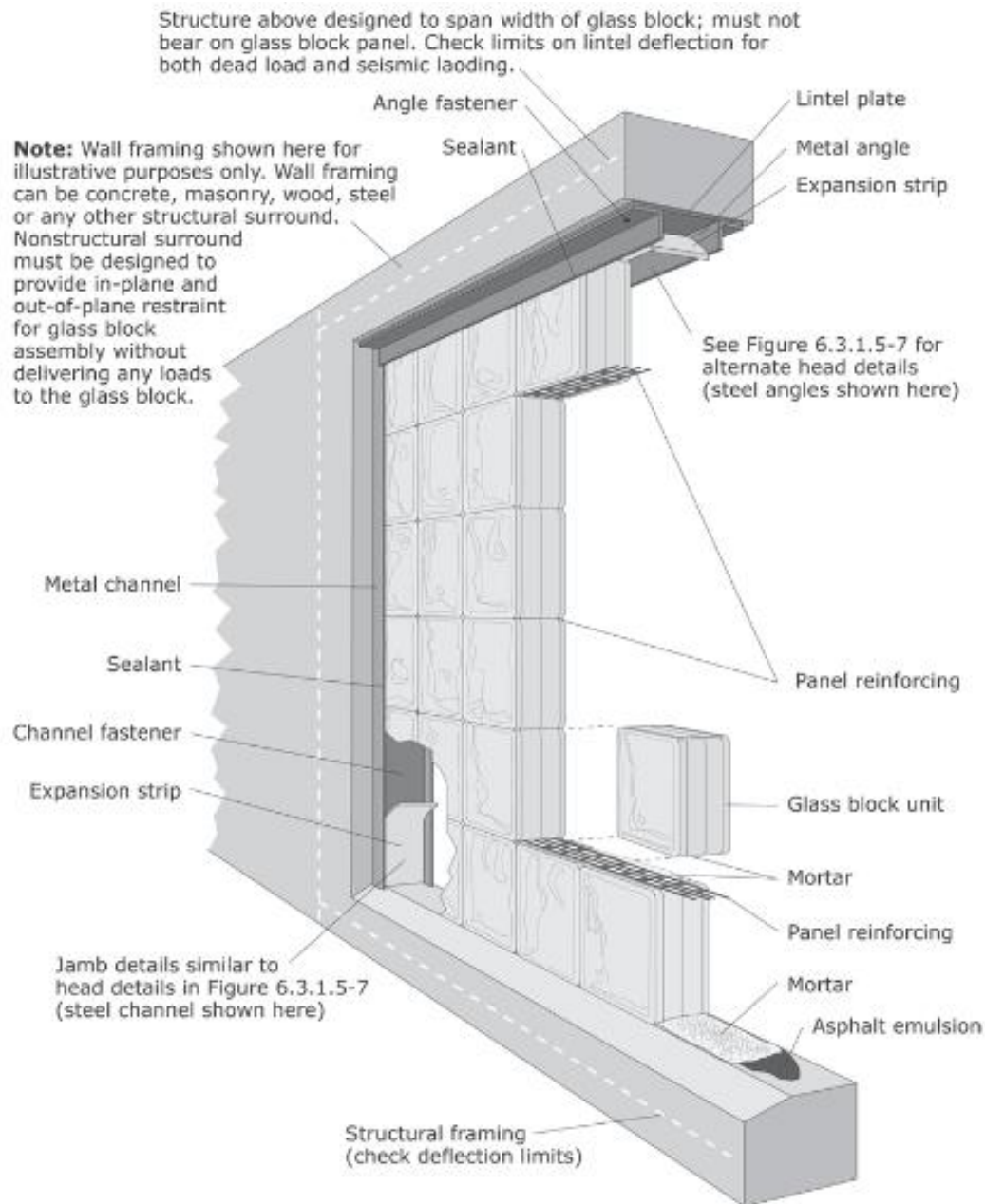


**Figure G-5. Full-height Glazed Partition.**

*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



**Figure G-6. Full-height Heavy Partition.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



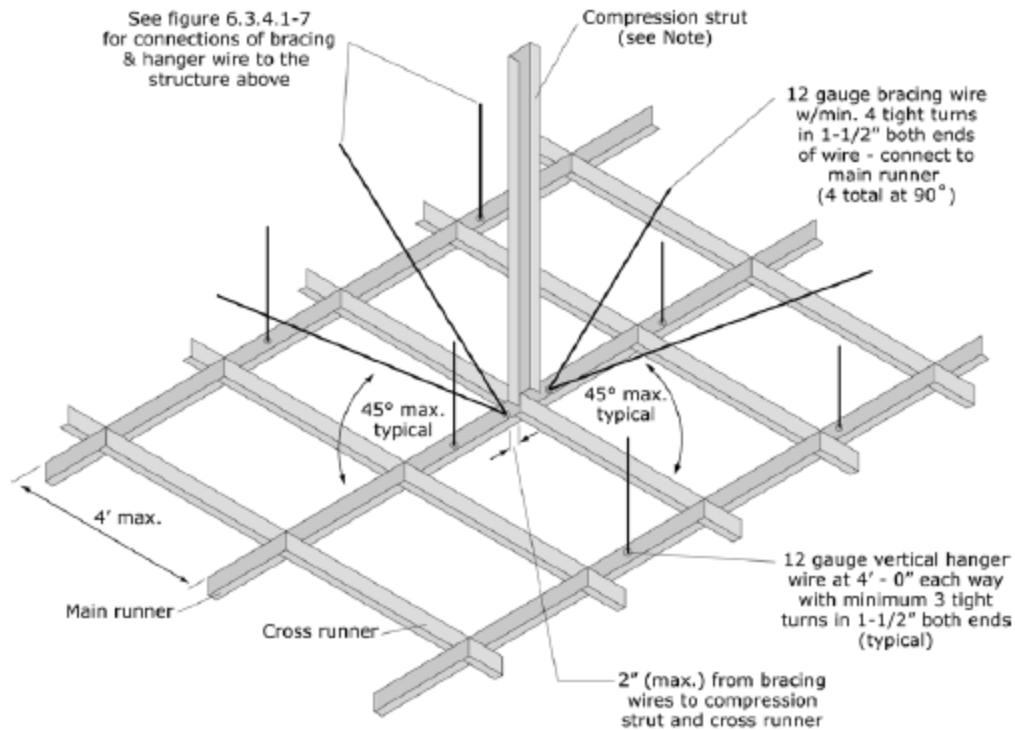
**Figure G-7. Typical Glass Block Panel Details.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



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**Washington State School Seismic Safety Assessments Project**

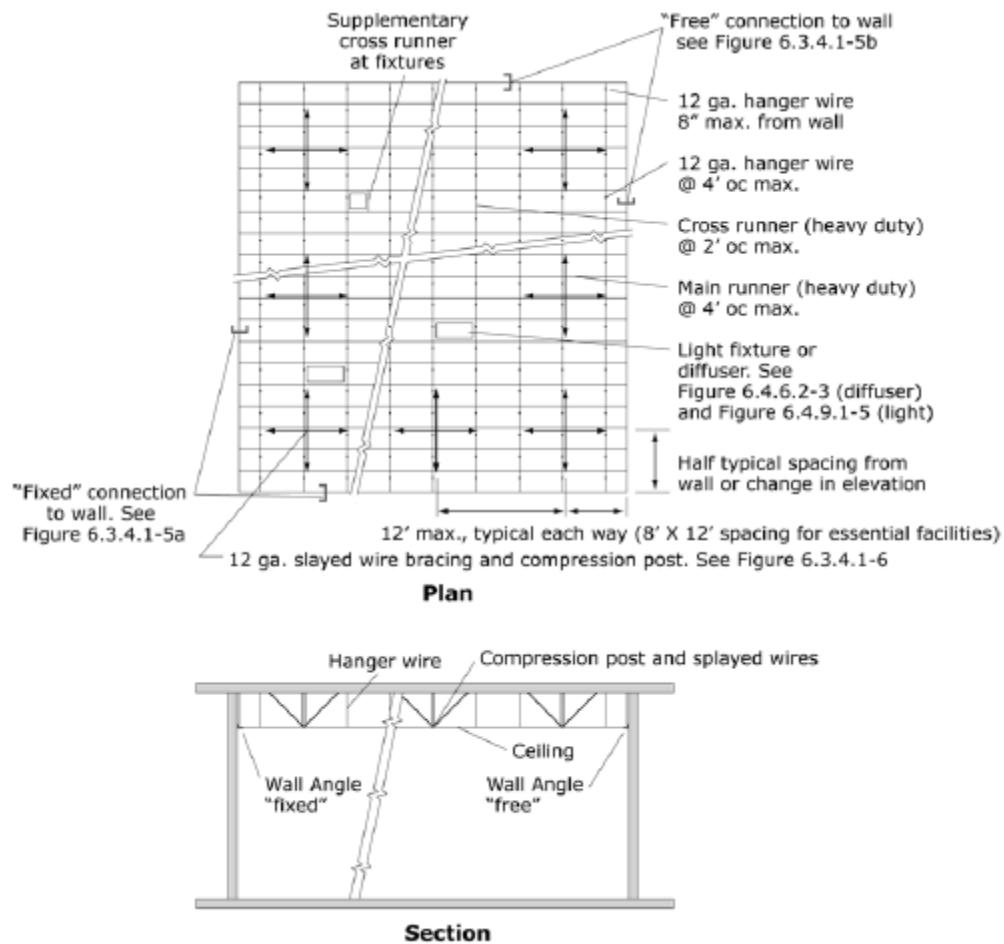




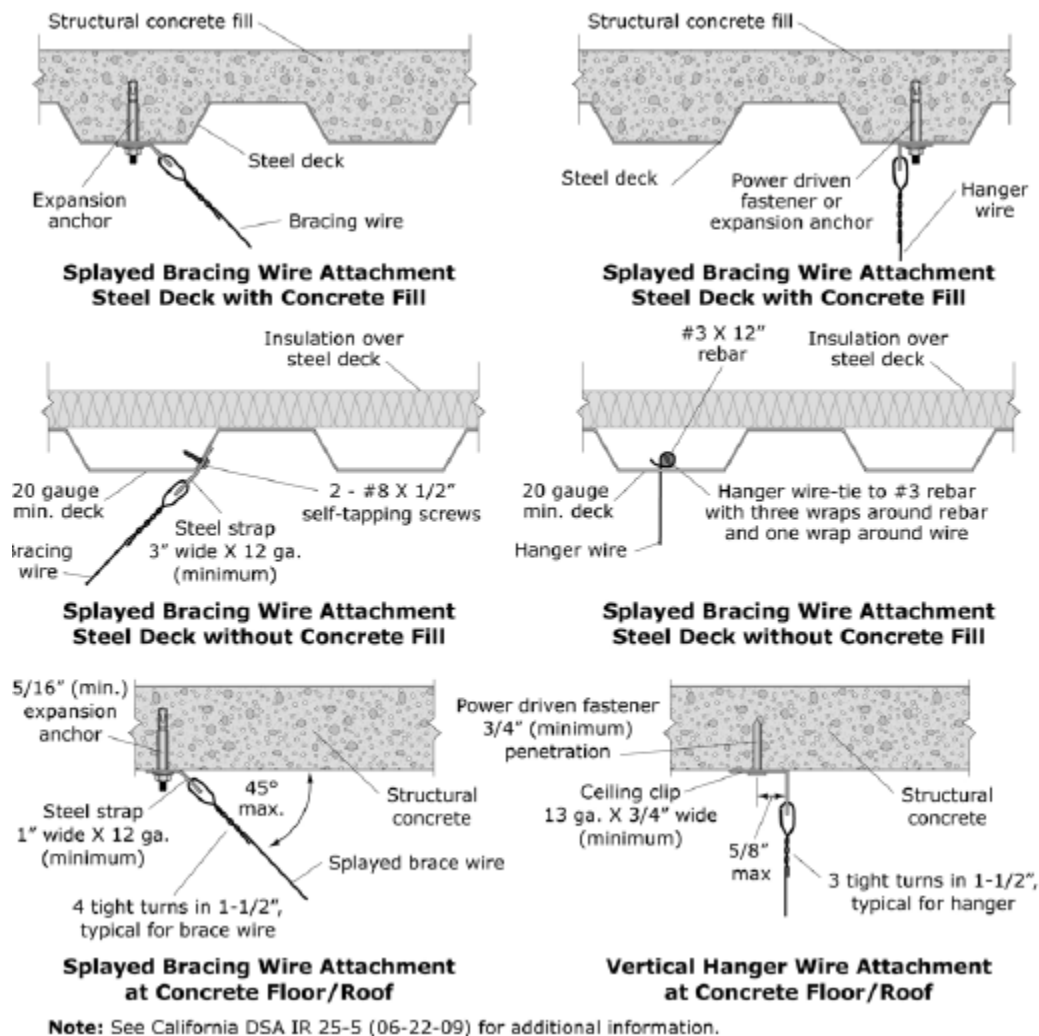
**Note:** Compression strut shall not replace hanger wire. Compression strut consists of a steel section attached to main runner with 2 - #12 sheet metal screws and to structure with 2 - #12 screws to wood or 1/4" min. expansion anchor to structure. Size of strut is dependent on distance between ceiling and structure ( $l/r \leq 200$ ). A 1" diameter conduit can be used for up to 6'; a 1-5/8" X 1-1/4" metal stud can be used for up to 10'

Per DSA IR 25-5, ceiling areas less than 144 sq. ft. or fire rated ceilings less than 96 sq. ft., surrounded by walls braced to the structure above do not require lateral bracing assemblies when they are attached to two adjacent walls. (ASTM E580 does not require lateral bracing assemblies for ceilings less than 1000 sq. ft.; see text.)

**Figure G-9. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Assembly.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)

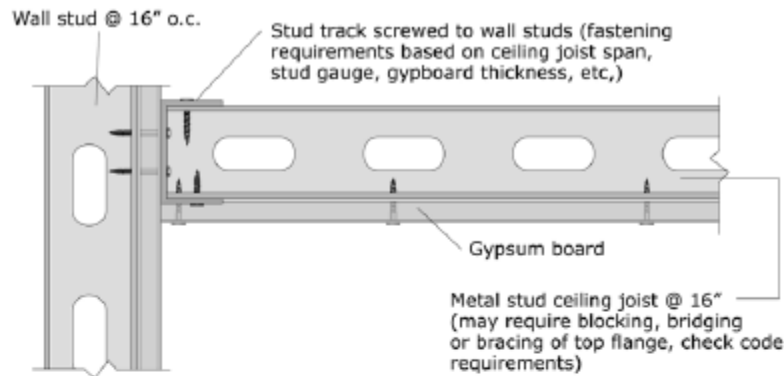


**Figure G-10. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Layout.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

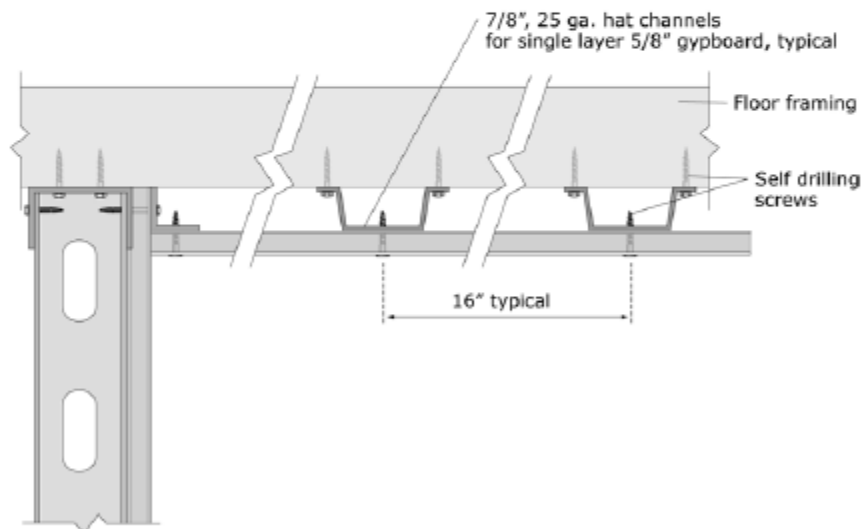


**Figure G-11. Suspension System for Acoustic Lay-in Panel Ceilings – Overhead Attachment Details.**

*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



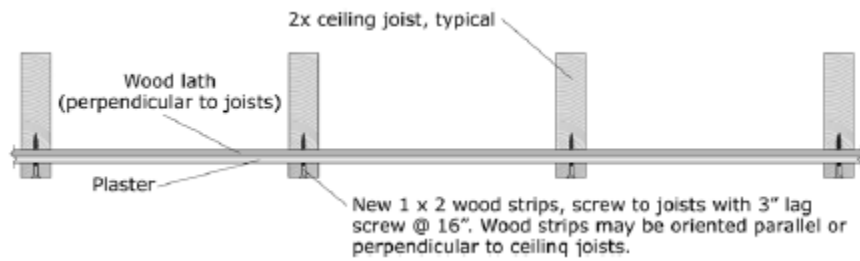
**a) Gypsum board attached directly to ceiling joists**



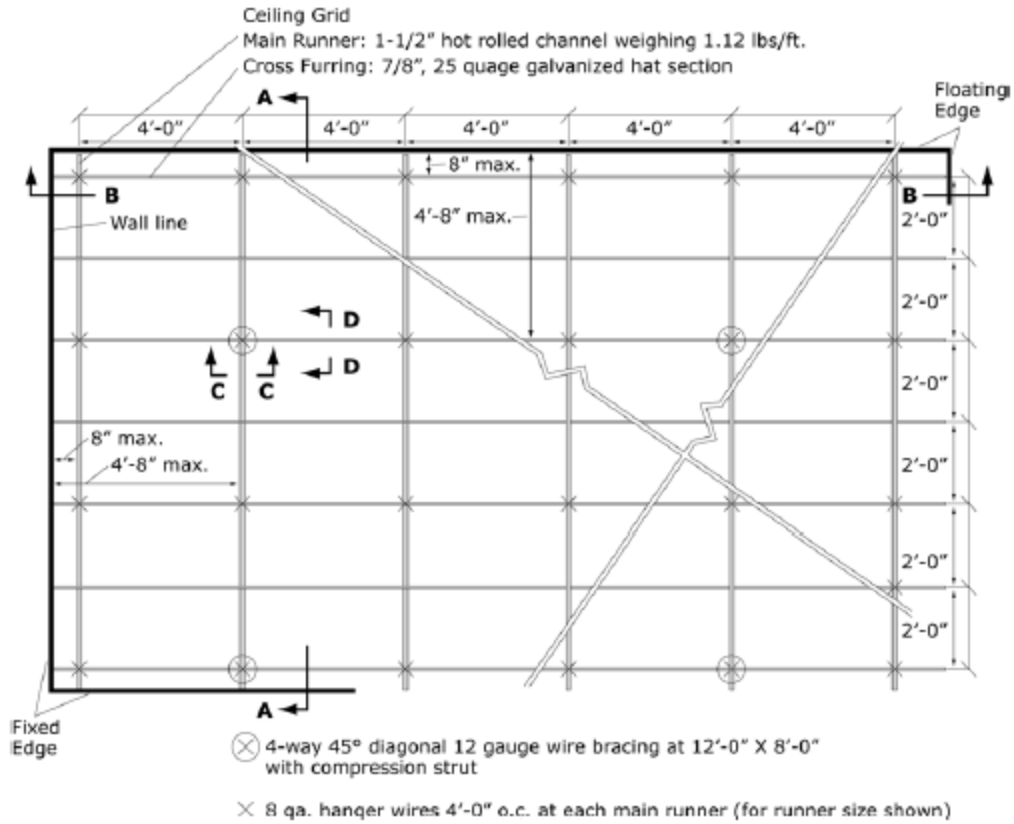
**b) Gypsum board attached directly to furring strips (hat channel or similar)**

Note: Commonly used details shown; no special seismic details are required as long as furring and gypboard secured. Check for certified assemblies (UL listed, FM approved, etc.) if fire or sound rating required.

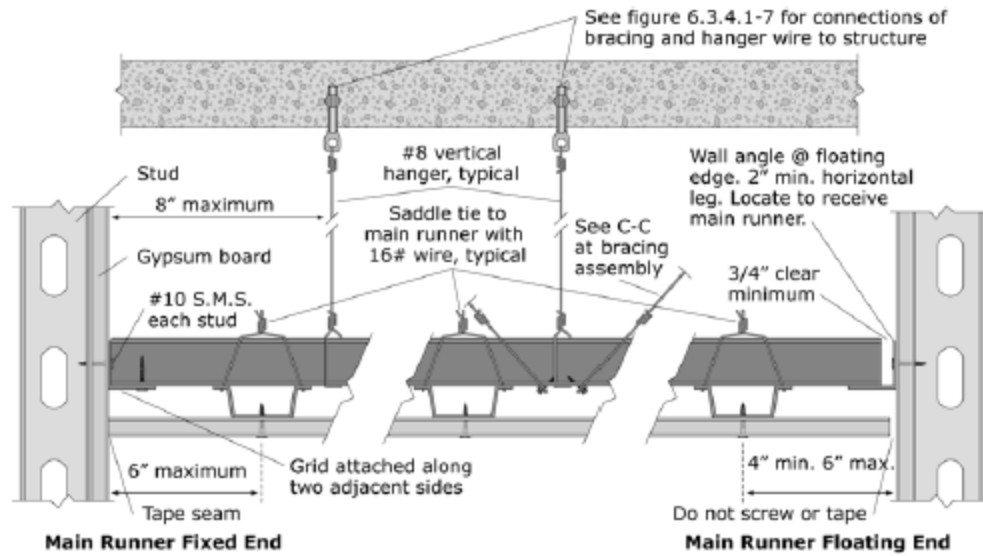
**Figure G-12. Gypsum Board Ceiling Applied Directly to Structure.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



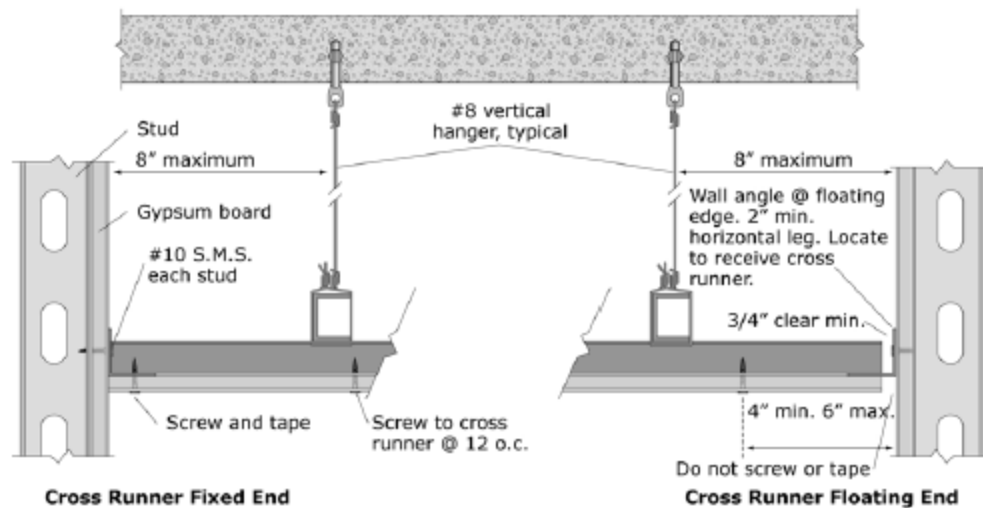
**Figure G-13. Retrofit Detail for Existing Lath and Plaster.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



**Figure G-14. Diagrammatic View of Suspended Heavy Ceiling Grid and Lateral Bracing.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



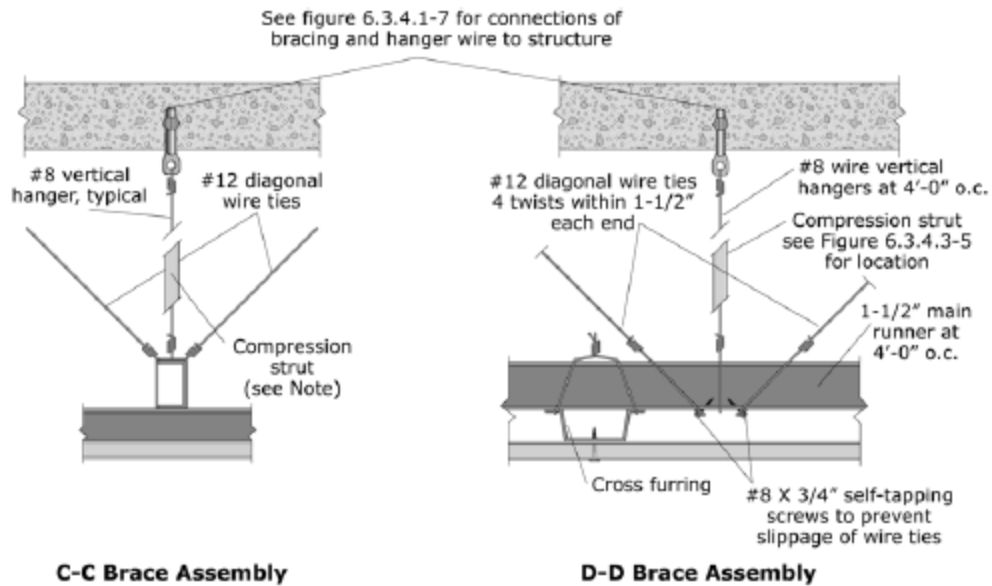
**A-A Main Runner at Perimeter**



**B-B Cross Runner at Perimeter**

**Figure G-15. Perimeter Details for Suspended Gypsum Board Ceiling.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

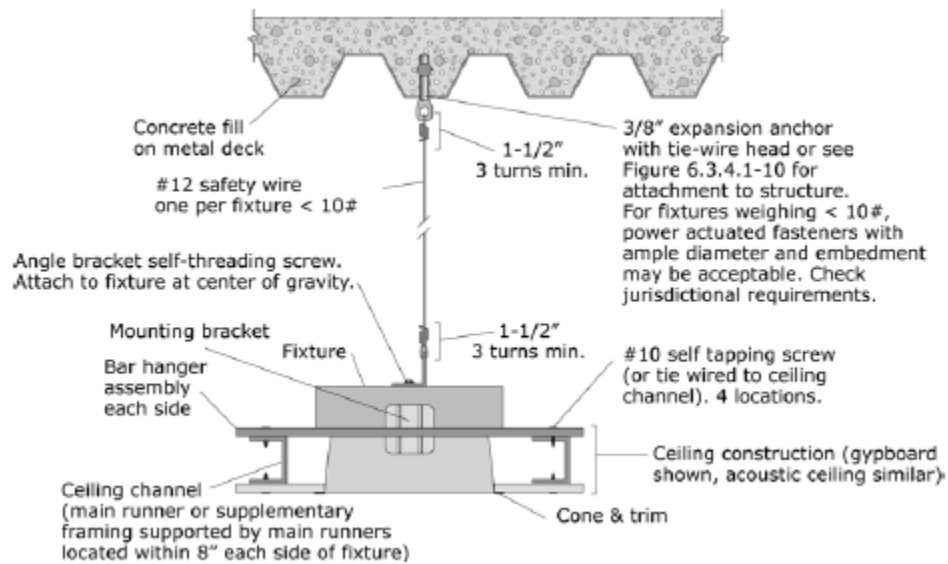




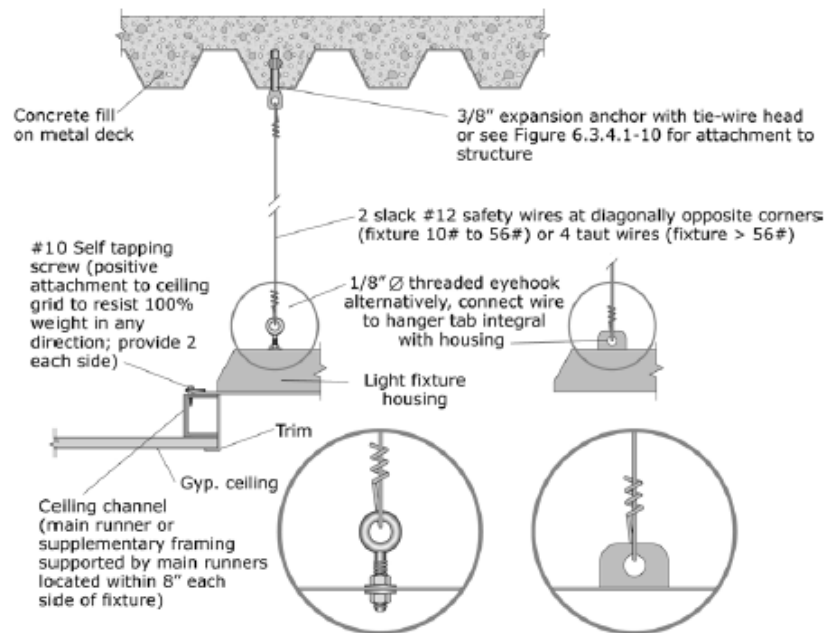
**Note:** Compression strut shall not replace hanger wire. Compression strut consists of a steel section attached to main runner with 2 - #12 sheet metal screws and to structure with 2 - #12 screws to wood or 1/4" min. expansion anchor to concrete. Size of strut is dependent on distance between ceiling and structure ( $l/r \leq 200$ ). A 1" diameter conduit can be used for up to 6', a 1-5/8" X 1-1/4" metal stud can be used for up to 10'. See figure 6.3.4.1-6 for example of bracing assembly.

**Figure G-16. Details for Lateral Bracing Assembly for Suspended Gypsum Board Ceiling.**  
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

## Light Fixtures

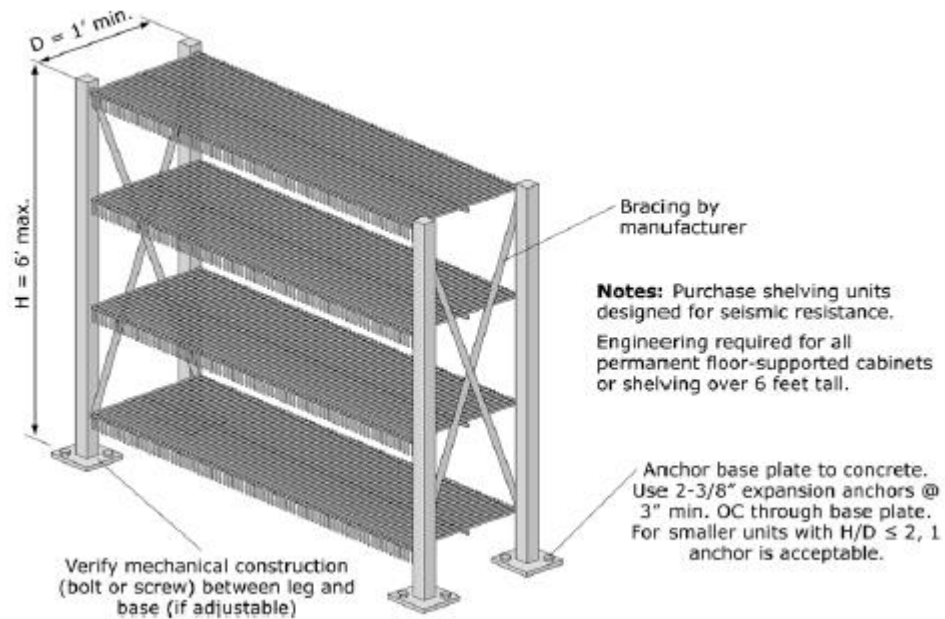


**Figure G-17. Recessed Light Fixture in suspended Ceiling (Fixture Weight < 10 pounds).**  
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

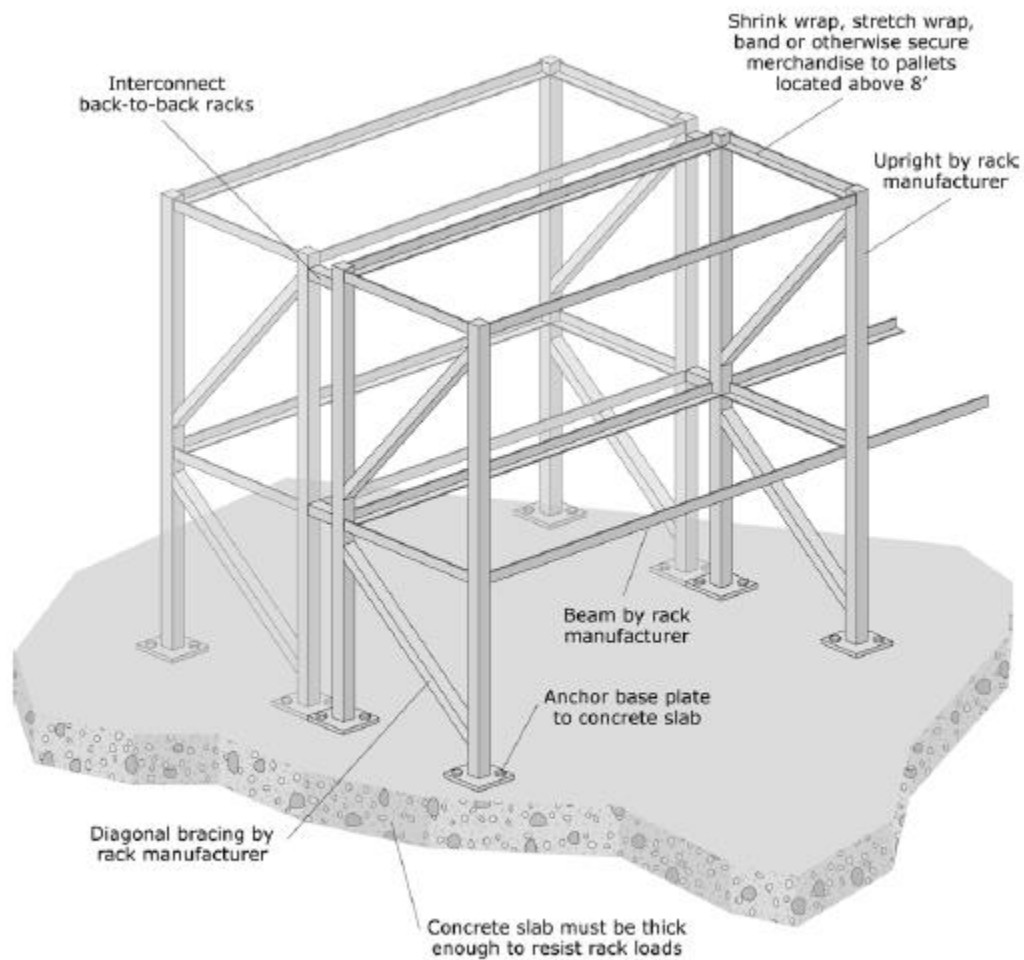


**Figure G-18. Recessed Light Fixture in suspended Ceiling (Fixture Weight 10 to 56 pounds).**  
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

## Contents and Furnishings

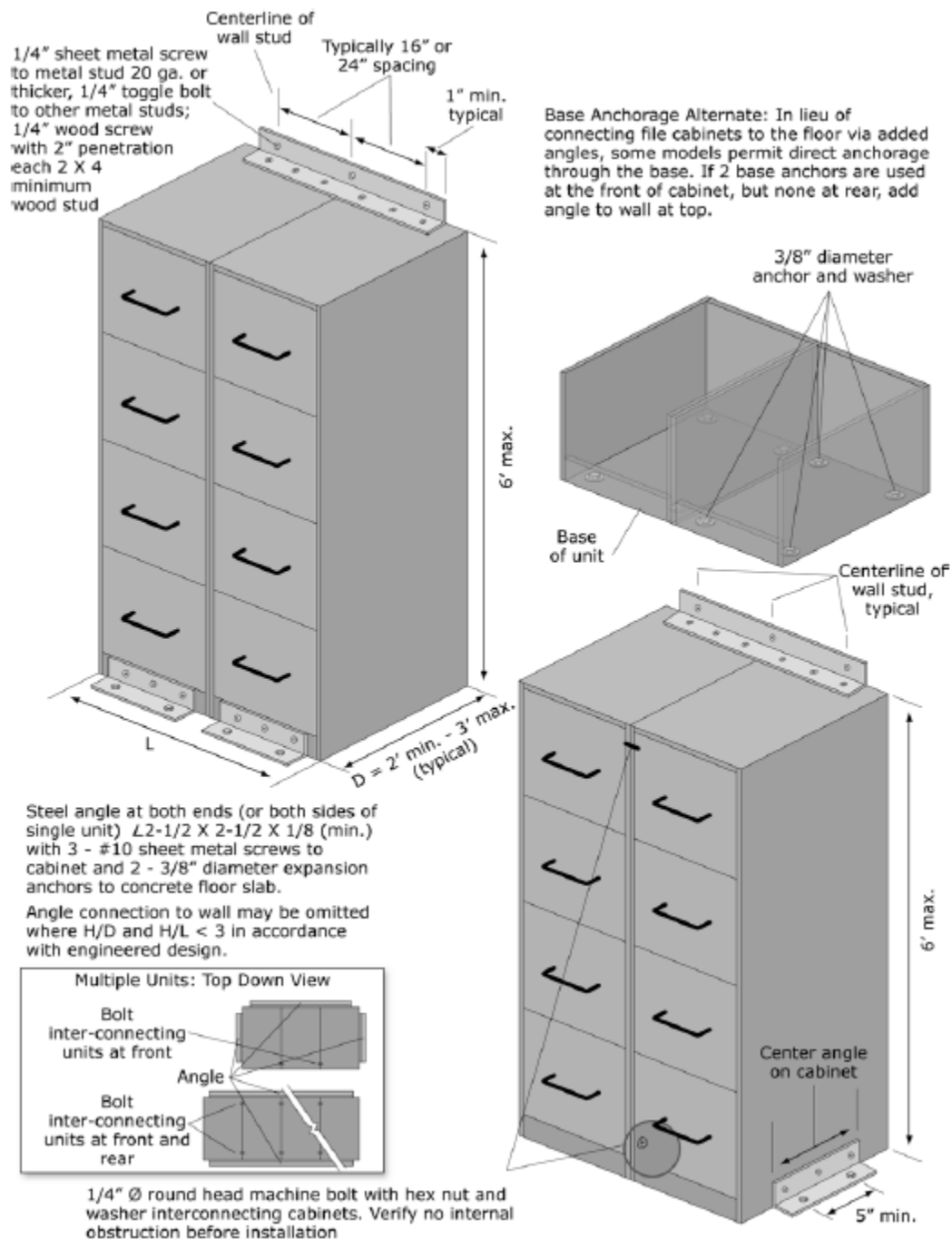


**Figure G-19. Light Storage Racks.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)

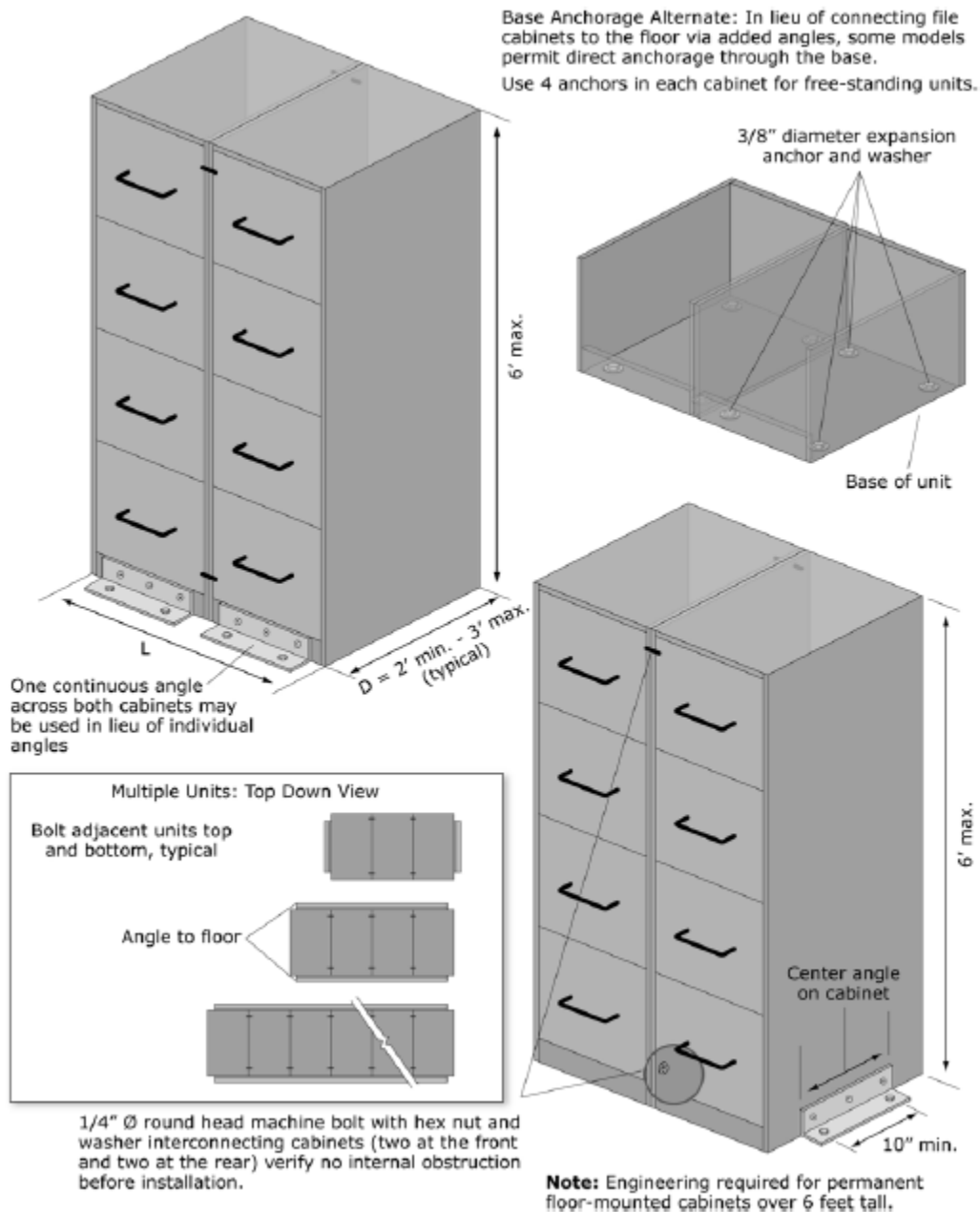


**Note:** Purchase storage racks designed for seismic resistance. Storage racks may be classified as either nonstructural elements or nonbuilding structures depending upon their size and support conditions. Check the applicable code to see which provisions apply.

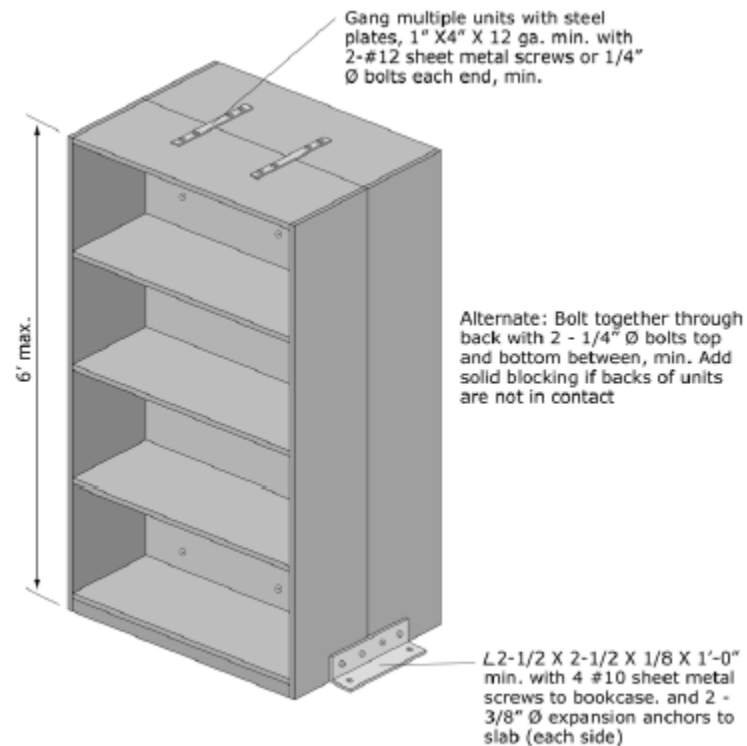
**Figure G-20. Industrial Storage Racks.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



**Figure G-21. Wall-mounted File Cabinets.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

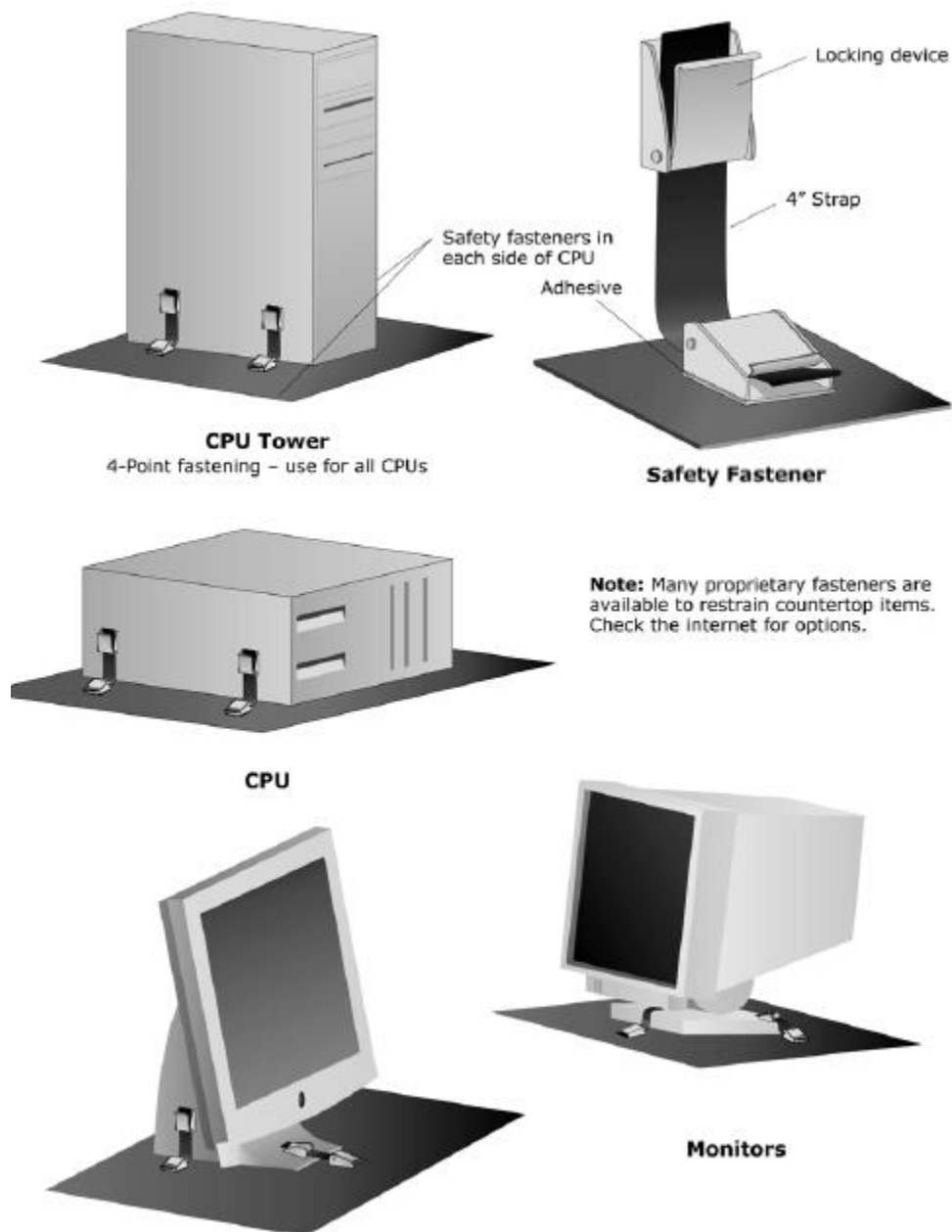


**Figure G-22. Base Anchored File Cabinets.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



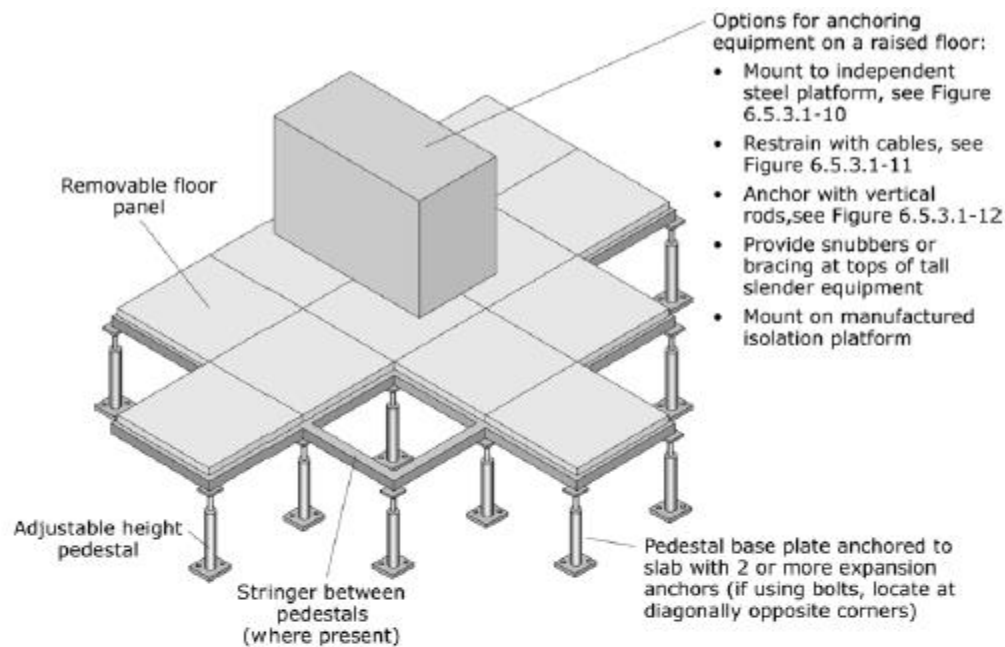
**Note:** Engineering required for all permanent floor-supported cabinets or shelving over 6 feet tall. Details shown are adequate for typical shelving 6 feet or less in height.

**Figure G-23. Anchorage of Freestanding Book Cases Arranged Back to Back.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

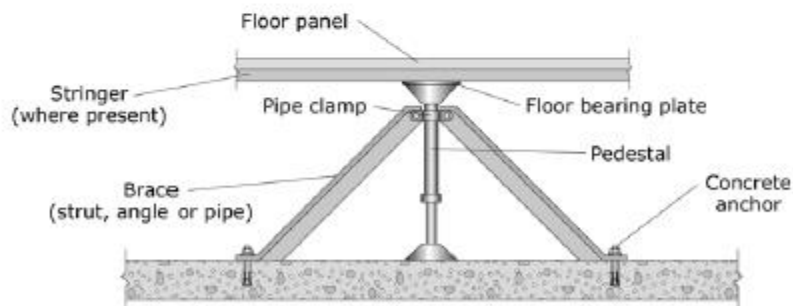


**Figure G-24. Desktop Computers and Accessories.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*





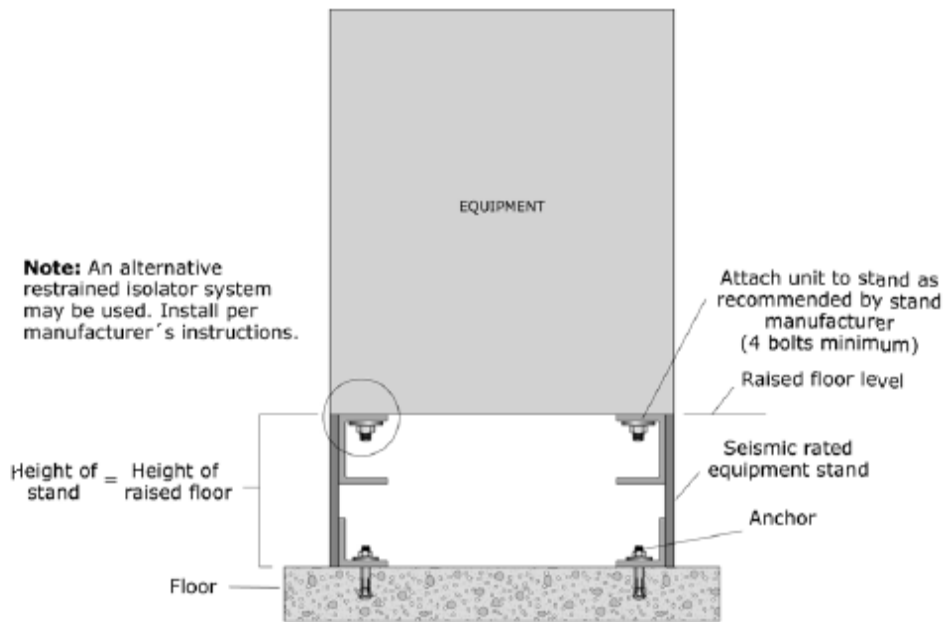
#### Cantilevered Access Floor Pedestal



#### Braced Access Floor Pedestal (use for tall floors or where pedestals are not strong enough to resist seismic forces)

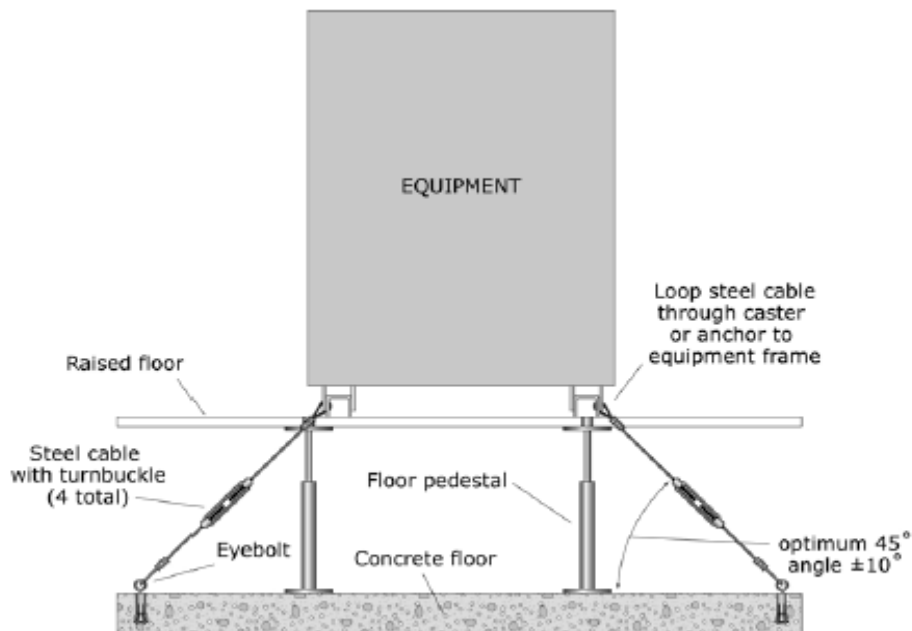
**Note:** For new floors in areas of high seismicity, purchase and install systems that meet the applicable code provisions for "special access floors."

**Figure G-25. Equipment Mounted on Access Floor.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



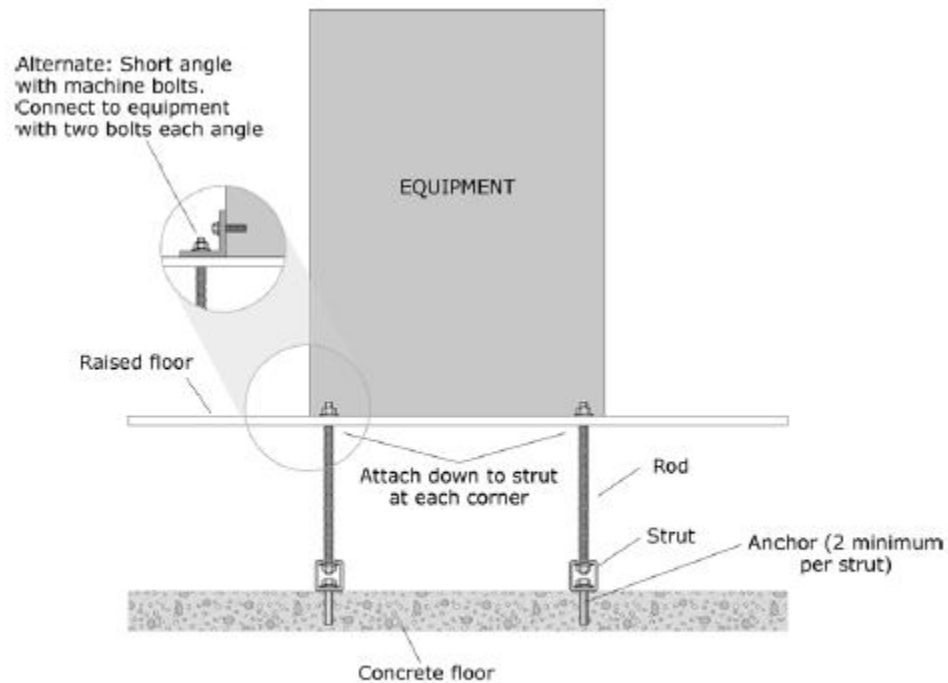
**Equipment installed on an independent steel platform within a raised floor**

**Figure G-26. Equipment Mounted on Access Floor – Independent Base.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



**Equipment restrained with cables beneath a raised floor**

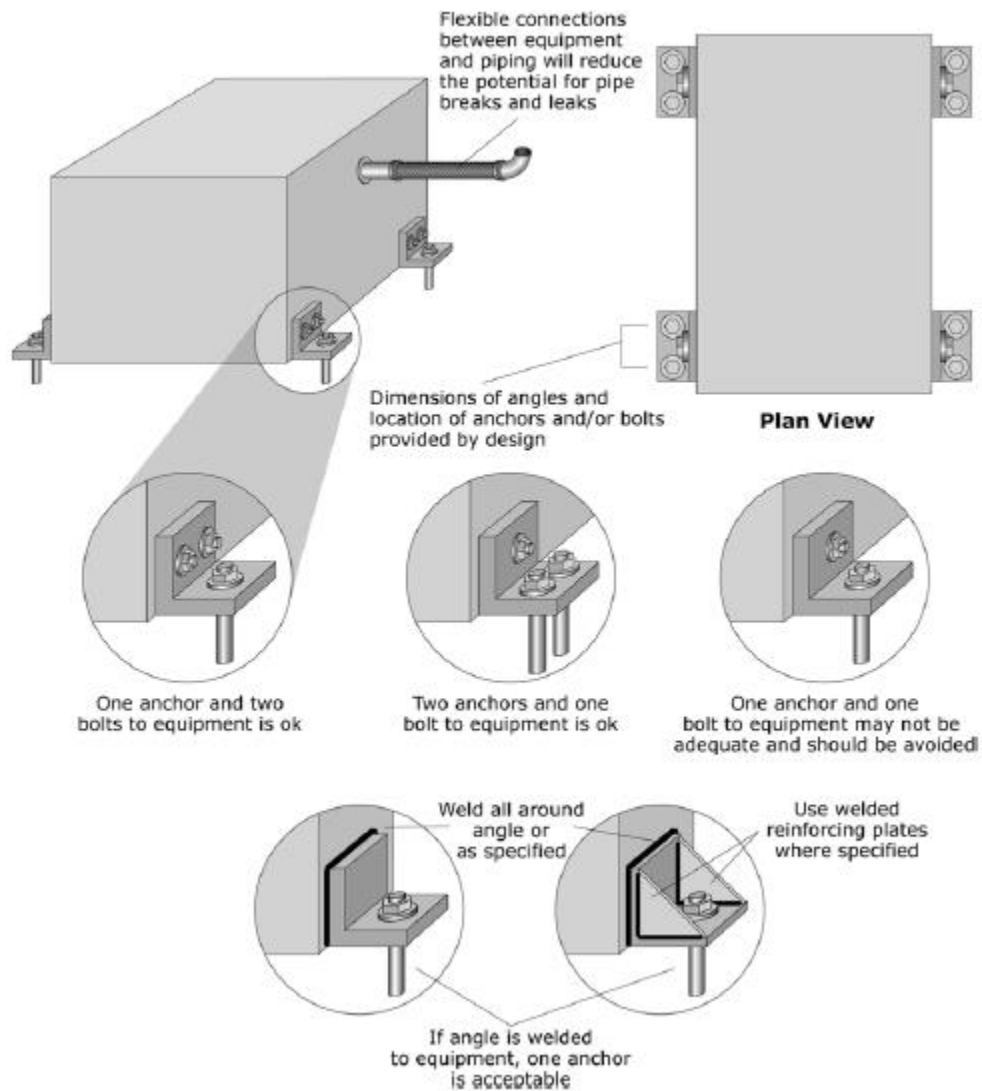
**Figure G-27. Equipment Mounted on Access Floor – Cable Braced.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



**Equipment anchored with vertical rods beneath a raised floor**

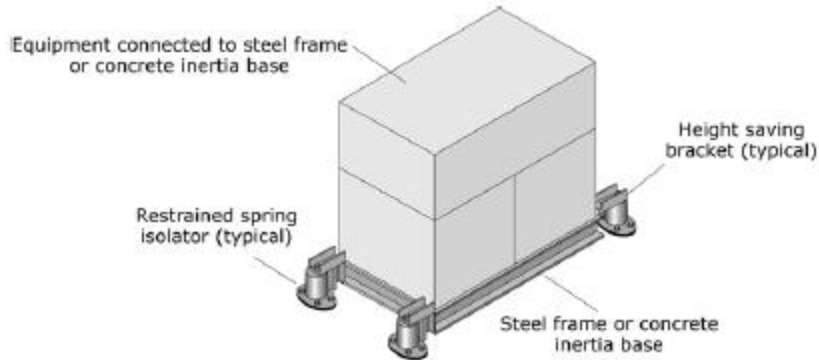
**Figure G-28. Equipment Mounted on Access Floor – Tie-down Rods.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

## Mechanical and Electrical Equipment

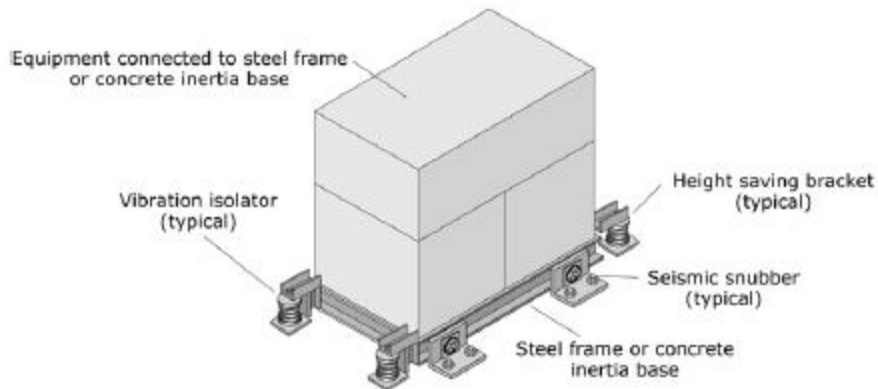


**Note:** Rigidly mounted equipment shall have flexible connections for the fuel lines and piping.

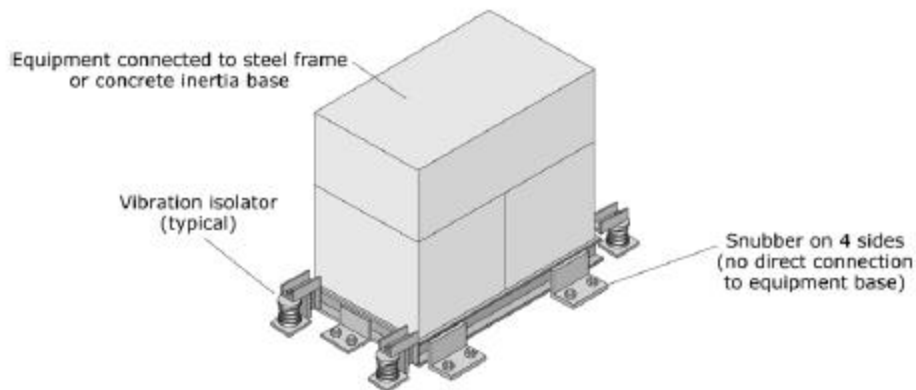
**Figure G-29. Rigidly Floor-mounted Equipment with Added Angles.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



**Supplemental base with restrained spring isolators**

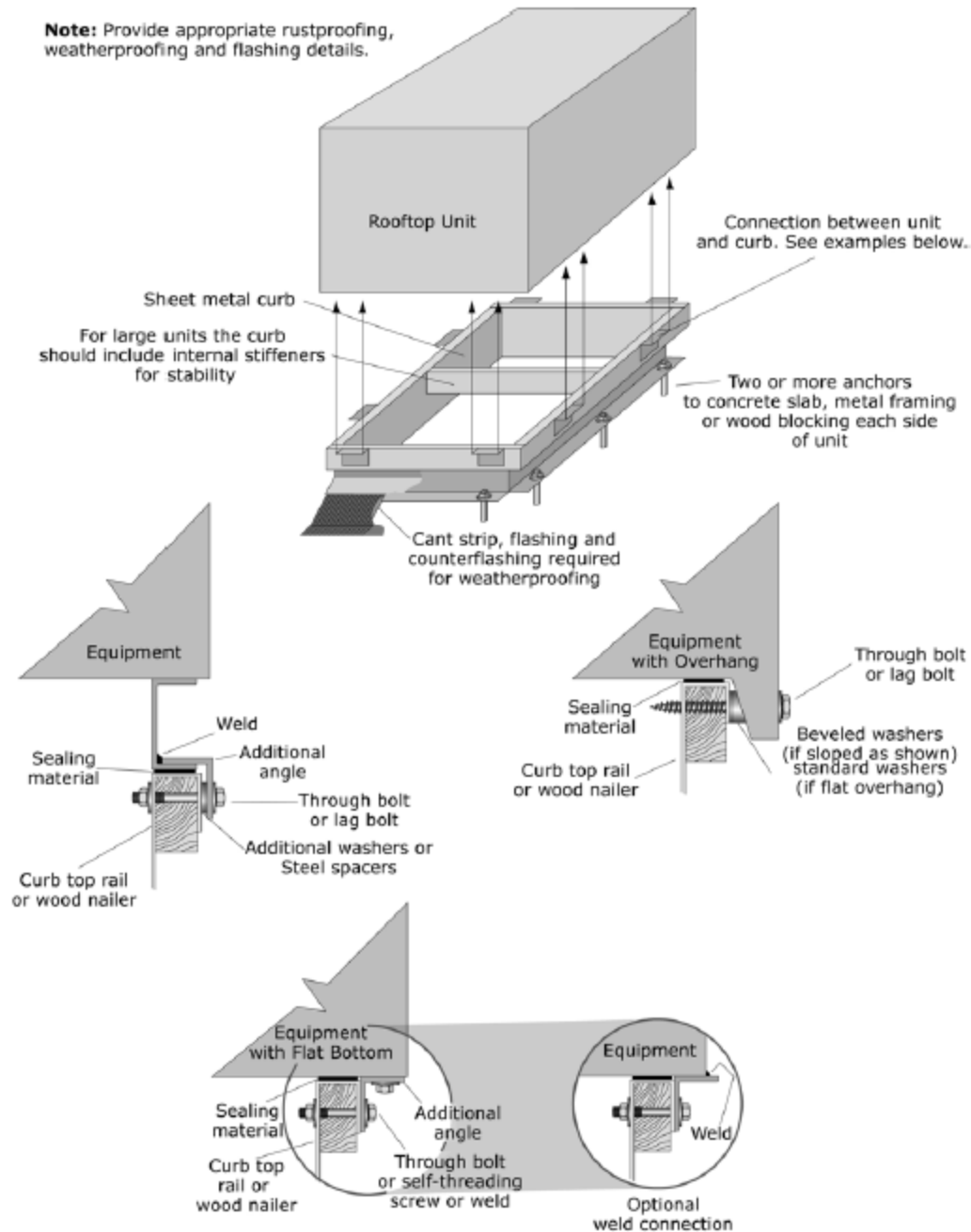


**Supplemental base with open springs and all-directional snubbers**

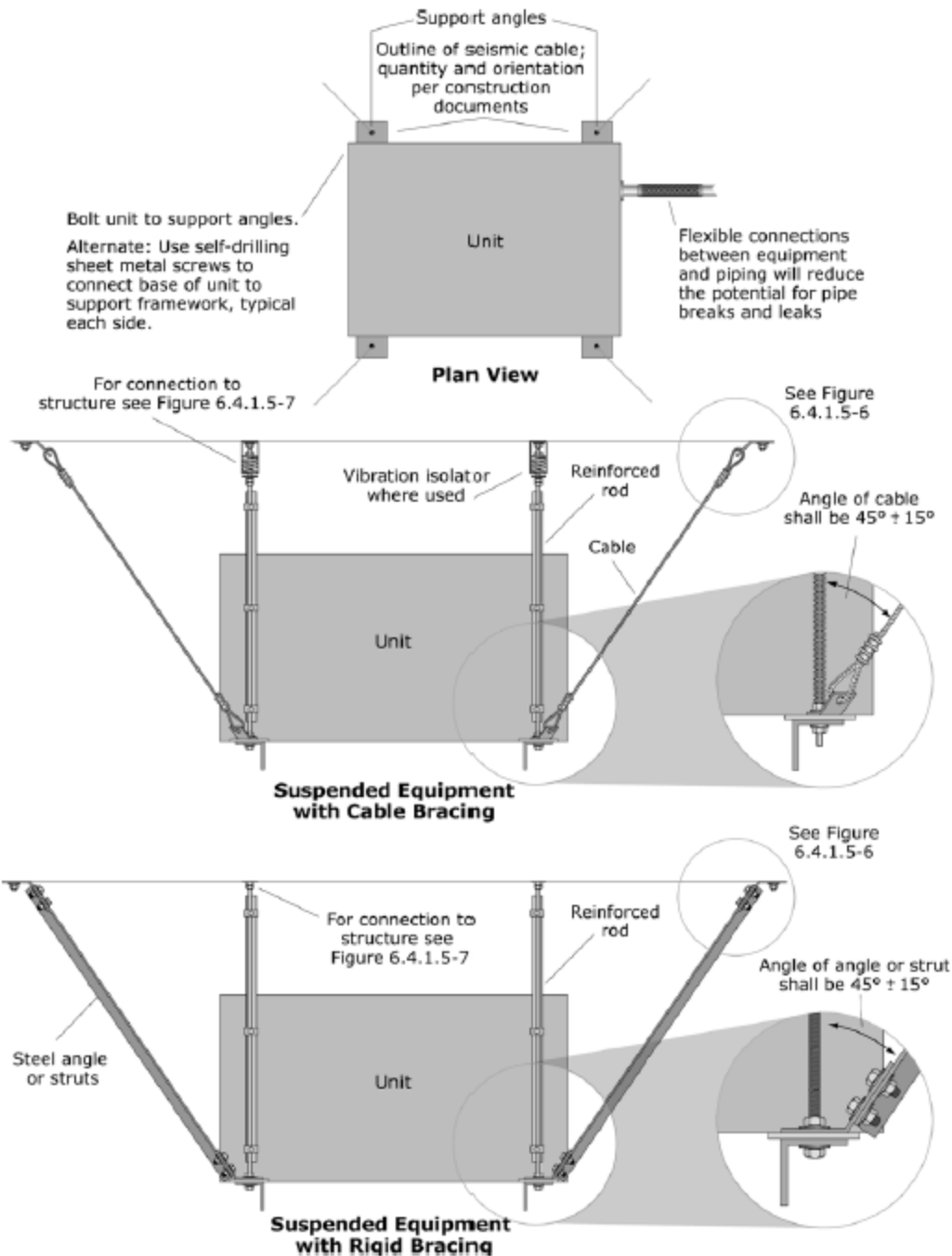


**Supplemental base with open springs and one-directional snubbers**

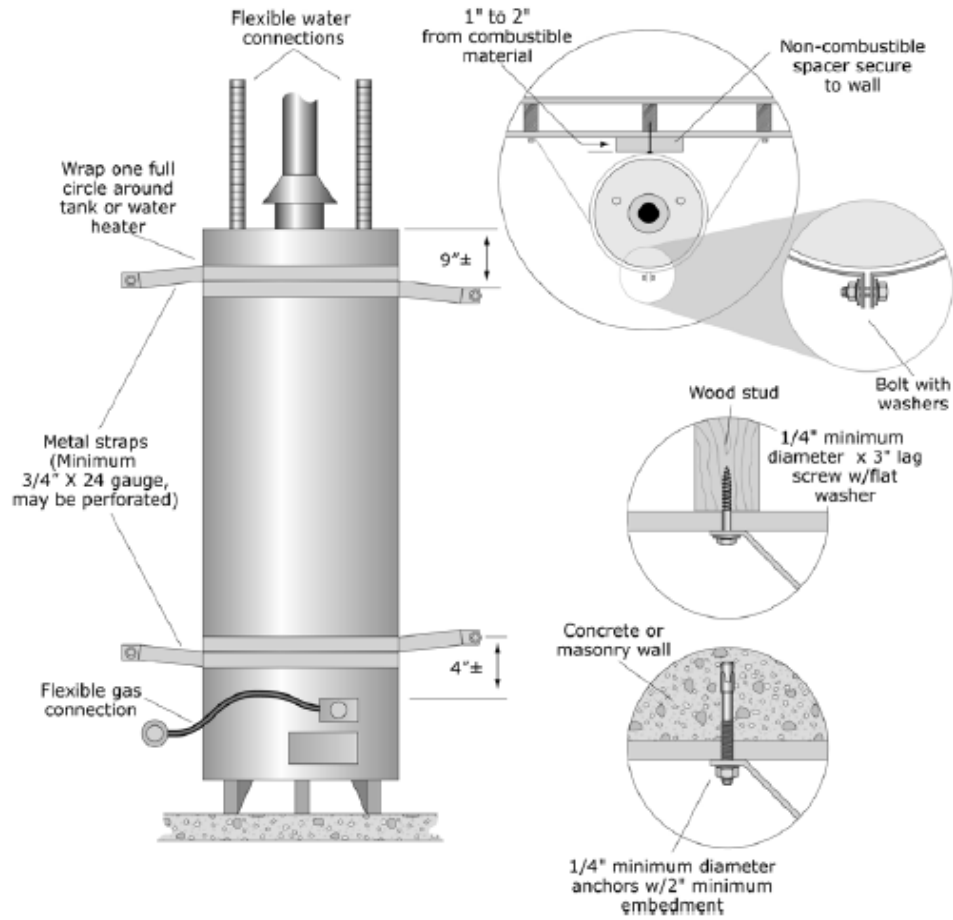
**Figure G-30. HVAC Equipment with Vibration Isolation.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



**Figure G-31. Rooftop HVAC Equipment.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

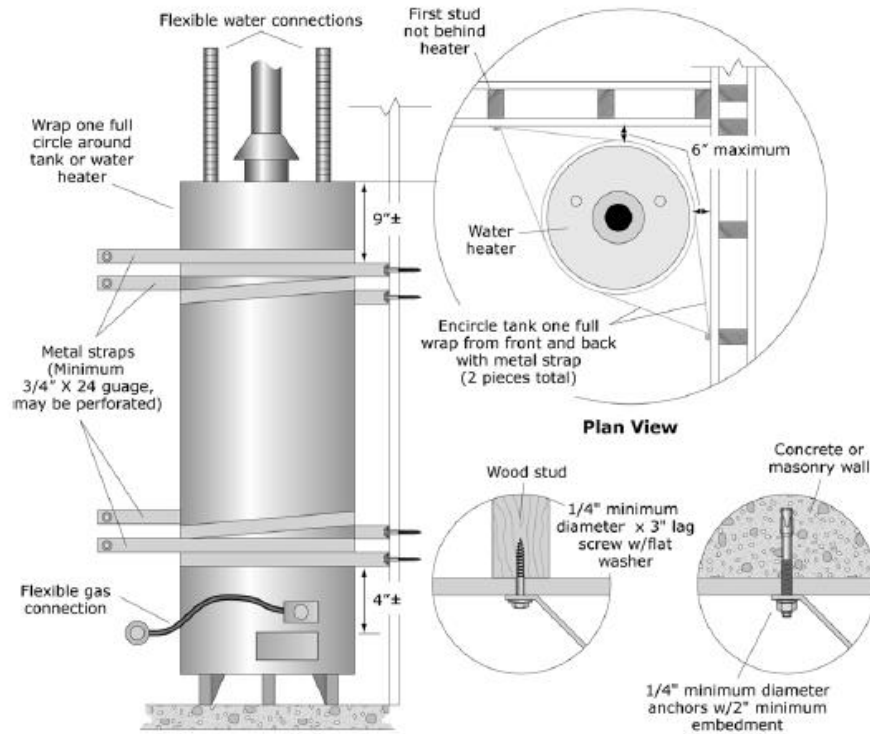


**Figure G-32. Suspended Equipment.**  
 (FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)

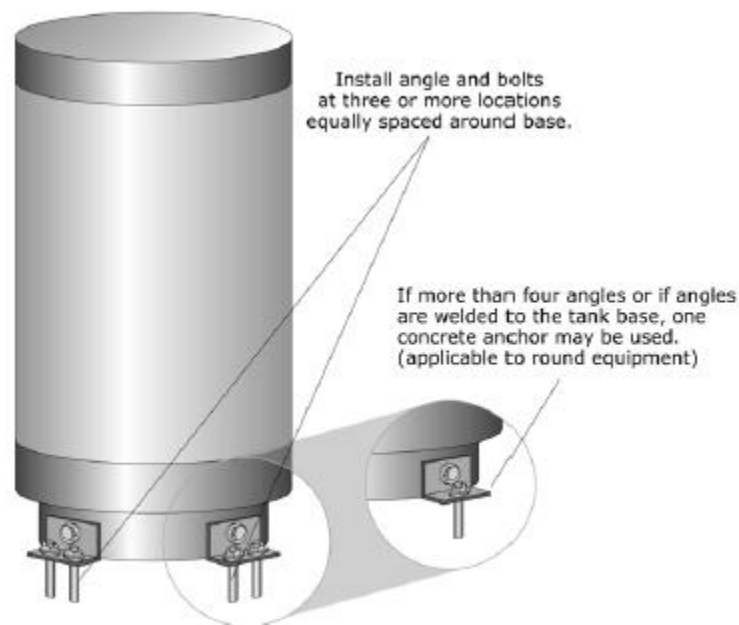


**Figure G-33. Water Heater Strapping to Backing Wall.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

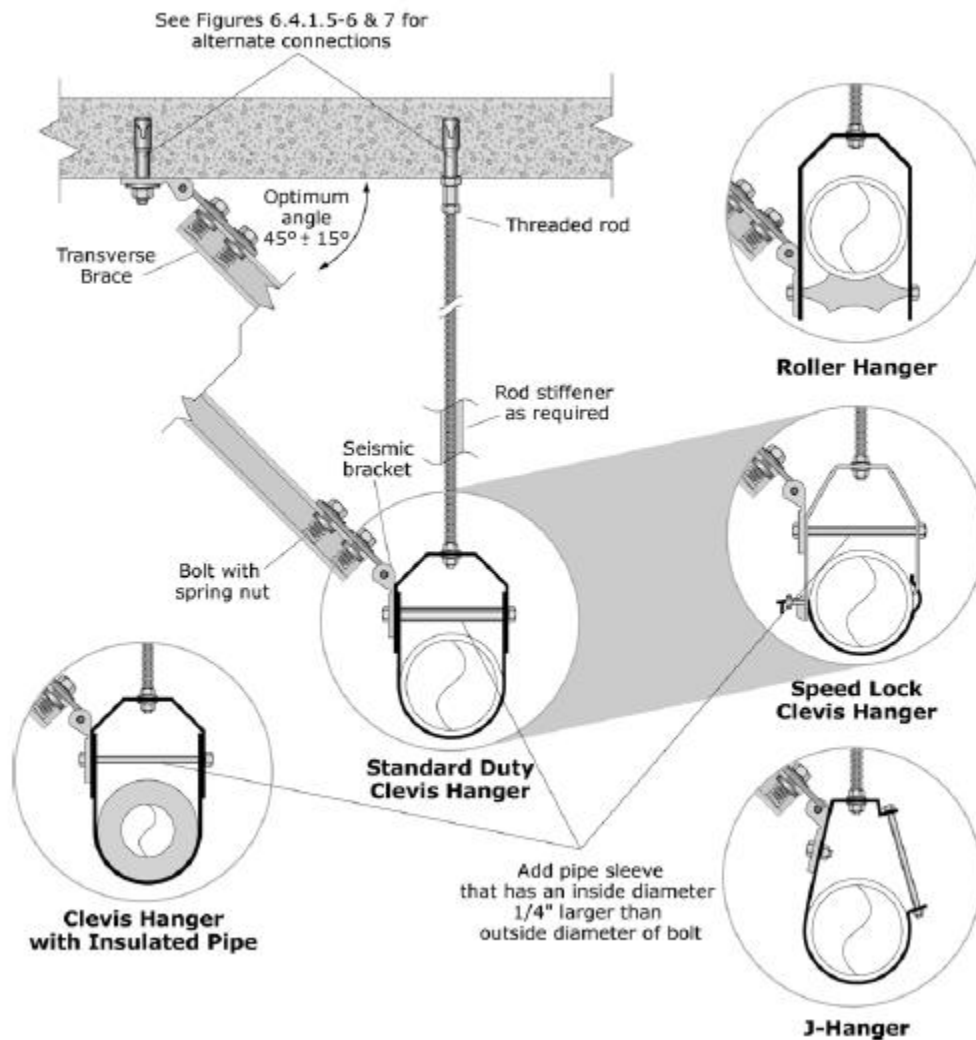




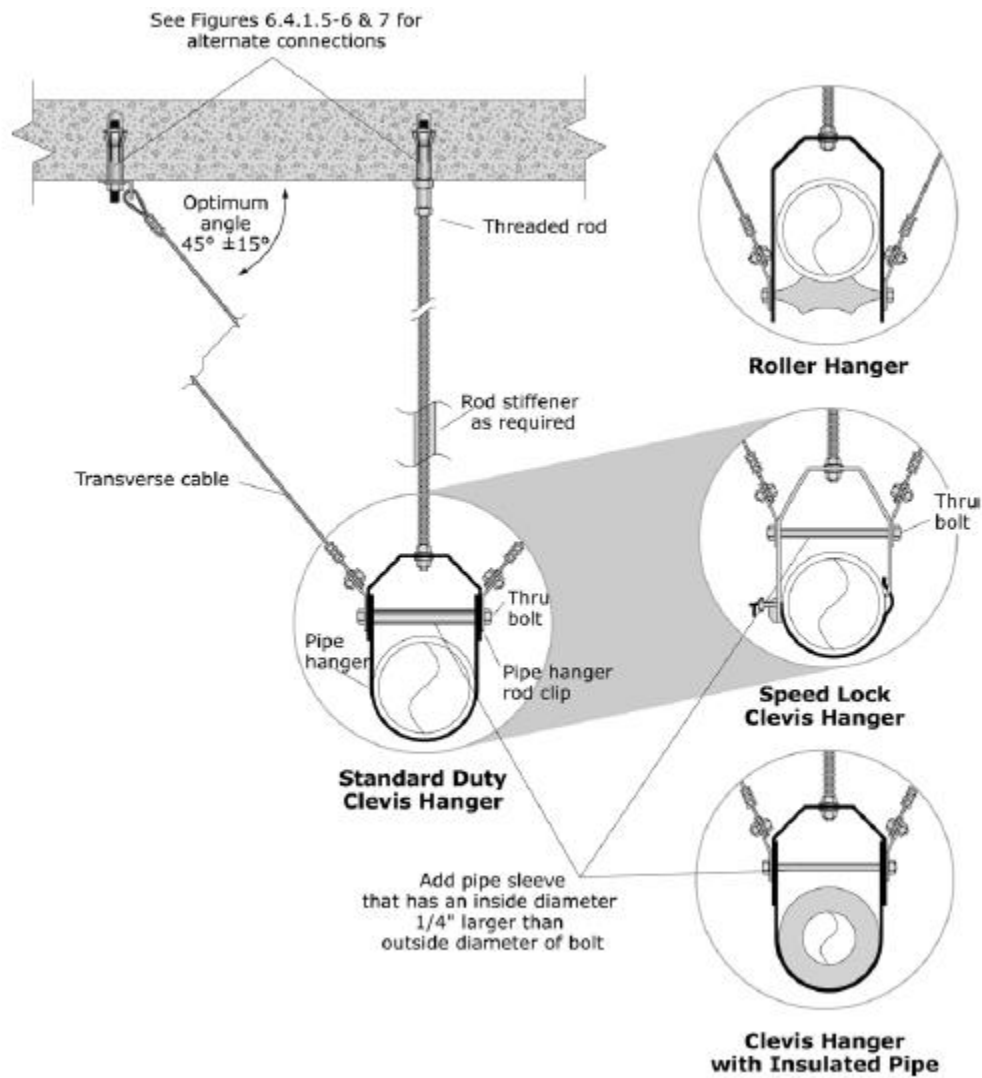
**Figure G-34. Water Heater – Strapping at Corner Installation.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



**Figure G-35. Water Heater – Base Mounted.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

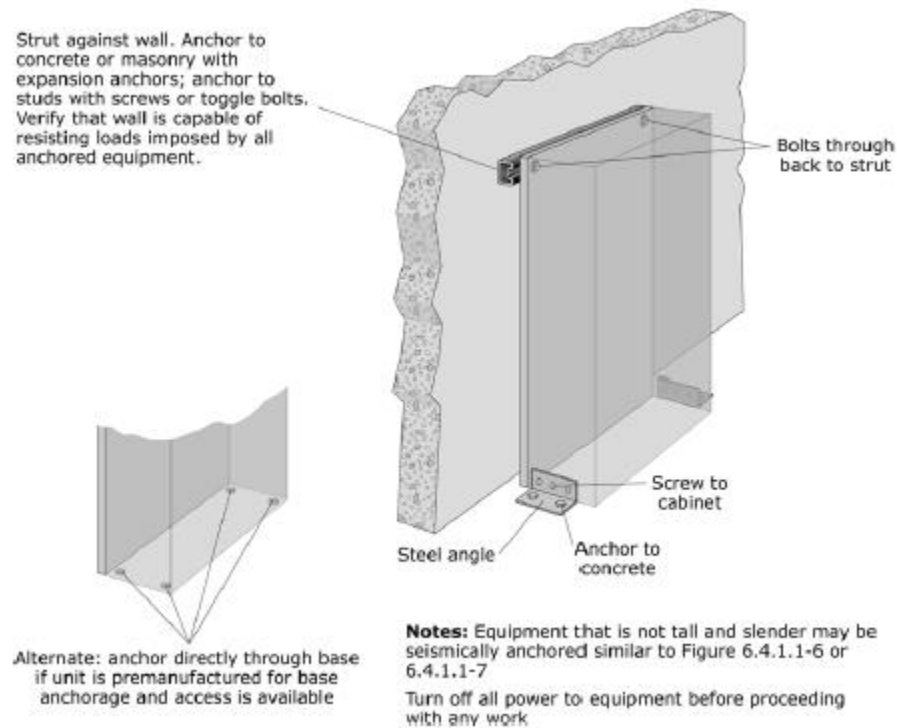


**Figure G-36. Rigid Bracing – Single Pipe Transverse.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

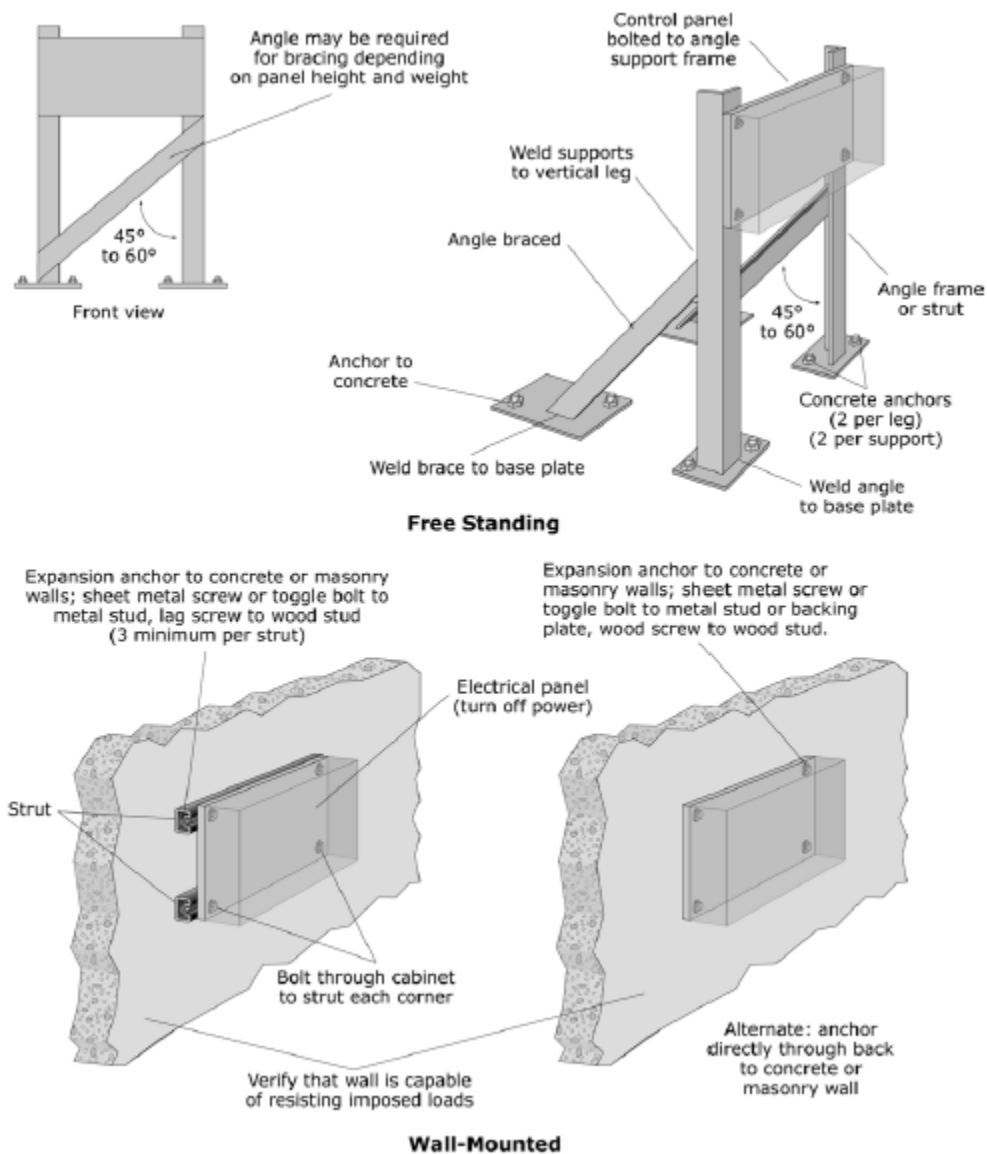


**Figure G-37. Cable Bracing – Single Pipe Transverse.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*

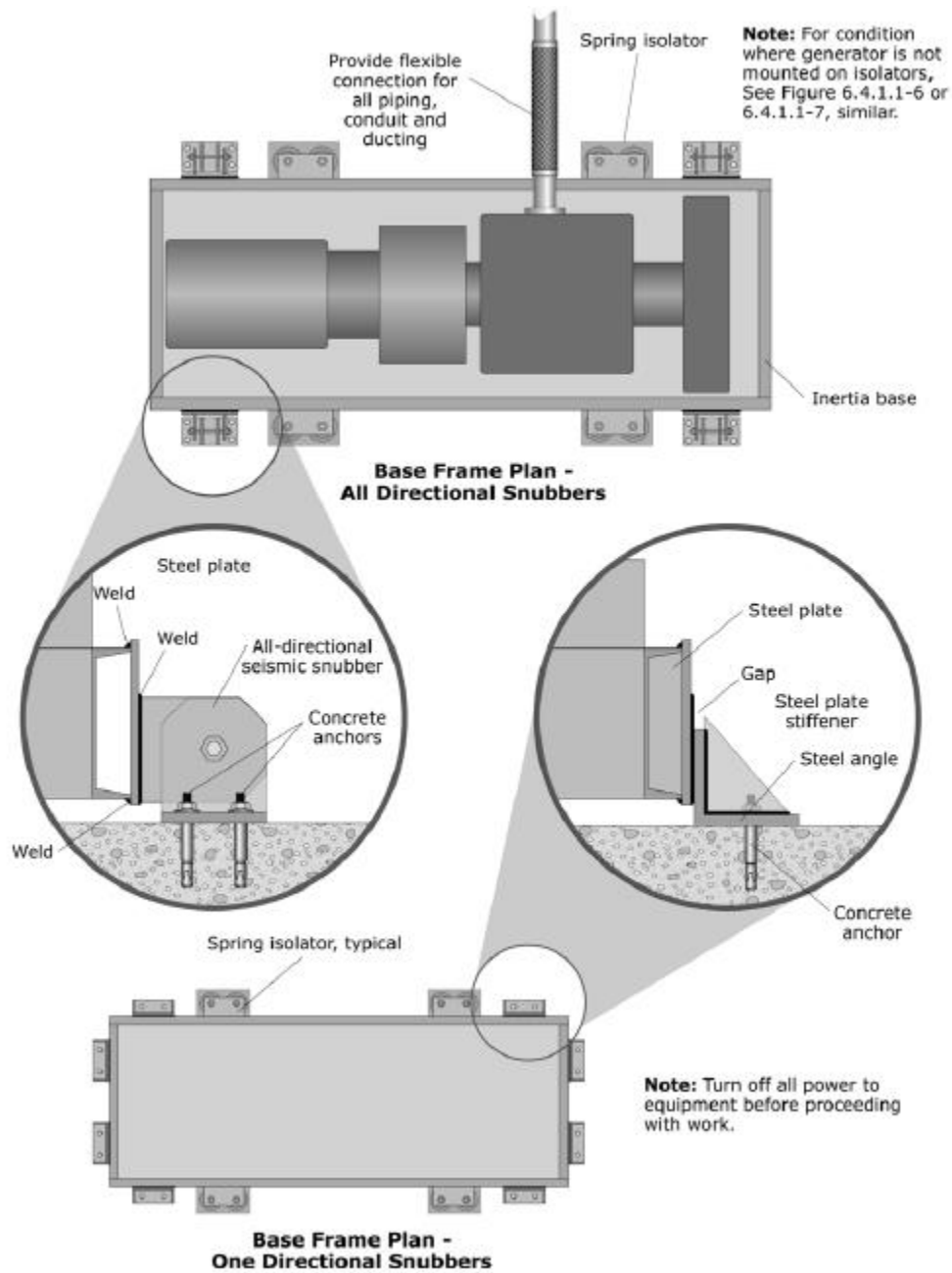
## Electrical and Communications



**Figure G-38. Electrical Control Panels, Motor Controls Centers, or Switchgear.**  
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)



**Figure G-39. Freestanding and Wall-mounted Electrical Control Panels, Motor Controls Centers, or Switchgear.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*



**Figure G-40. Emergency Generator.**  
*(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)*